UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAY 19 2015

Mr. Thomas Frick
Director
Division of Environmental Assessment & Restoration
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Dear Mr. Frick:

The U. S. Environmental Protection Agency has completed its review and is approving the Hierarchy 1 Site Specific Numeric Interpretations for various waterbodies incorporated as a web link in Chapter 62-302.531(2)(a) as provisions in Chapter 62-304 Total Maximum Daily Load (TMDL), Florida Administrative Code (F.A.C). Florida Department of Environmental Protection submitted revised Chapter 62-304, F.A.C. including the numeric nutrient criteria (NNC) for the subject waters, to the EPA on June 13, 2012, as new or revised water quality standards (WQS) with the necessary supporting documentation and certification by FDEP General Counsel, pursuant to 40 CFR Part 131. The NNC were adopted under various provisions in Chapter 62-304, TMDLs as site specific numeric interpretations of paragraph 62-302.530(47)(b), F.A.C., as referenced in paragraph 62-302.531(2)(a), F.A.C. FDEP intends for the submitted NNC to serve in place of the otherwise applicable criteria set out in paragraph 62-302.531(2)(b), F.A.C.

In accordance with section 303(c) of the Clean Water Act, I am hereby approving the aforementioned NNC for various waterbodies that are incorporated as a web link in Chapter 62-302.531(2)(a) as revised WQS for total nitrogen and/or total phosphorus. Any other criteria applicable to the waterbodies remain in effect, especially those related to chlorophyll *a* in paragraph 62-302.531 2.(b)1., and including other applicable criteria at 62-302.531(2)(b). The requirements of paragraph 62-302.530(47)(a), F.A.C. also remain applicable. The details of the NNC are discussed in the enclosed documentation.

We would like to commend you and your staff for your continued efforts in environmental protection for the State of Florida. If you have any questions regarding the EPA's approval, please contact me at (404) 562-9345 or have a member of your staff contact Ms. Cecelia Ann Harper, in the Water Quality Standards Section at (404) 562-9418.

Sincerely,

James D. Giattina
Director
Water Protection Division

Enclosure

cc: Mr. Craig D. Varn, FDEP
Mr. Eric Shaw, FDEP

Shared: Remaining2012 H1 Approval Letter.docx

Decision Document of the
United States Environmental Protection Agency Determination
Under § 303(c) of the Clean Water Act for the
Review of Hierarchy 1 Site Specific Numeric Interpretations For Various Waterbodies
Incorporated as a Web Link in Chapter 62-302.531(2)(a) and as provisions in
Chapter 62-304 TMDLs, Florida Administrative Code

INTRODUCTION

On June 13, 2012, Florida Department of Environmental Protection submitted new or revised water quality standards (WQS) for review by the U.S. Environmental Protection Agency pursuant to section 303(c) of the Clean Water Act (CWA). These new and revised WQS are set out in Rule 62-302.531 titled Numeric Interpretations of Narrative Nutrient Criteria of the Florida Administrative Code (F.A.C.) and were approved by the EPA on November 20, 2012.

The aforementioned submittal contained a web link in section 62-302.531(2)(a) as http://www.dep.state.fl.us/water/wqssp/swq-docs.htm (more directly accessed at this web link http://www.dep.state.fl.us/water/wqssp/docs/swqdocs/nutrient-tmdl-list.pdf) which incorporates by reference a waterbody list interpreting paragraph 62-302.530(47)(b), F.A.C. as Hierarchy 1 site specific numeric interpretations (H1s). The table of waterbodies, incorporated as a web link (Attachment 1), further cross references to entries in Chapter 62-304, F.A.C., which codifies FDEP adopted Total Maximum Daily Loads (TMDLs). Chapter 62-304 contains waterbody specific details regarding the H1s addressed in this decision criteria, which are themselves also considered WQS by the EPA.

The EPA has previously approved many of these H1s as outlined below; this serves as the culminating action completing the EPA's decision for the remaining H1s contained in the web link table, including the cross referenced TMDLs codified in Chapter 62-304, F.A.C. As described more fully below, where the EPA has determined that the subject H1s are themselves new or revised WQS, the EPA has reviewed and is approving them pursuant to section 303(c) of the CWA.

Clean Water Act Requirements

Section 303 of the CWA, 33 U.S.C. § 1313, requires states to establish WQS and to submit any new or revised standards to the EPA for review and approval or disapproval. The EPA's implementing regulations require states to adopt water quality criteria that protect the designated use. See 40 C.F.R. § 131.11(a). Such criteria must be based on a sound scientific rational and must contain sufficient parameters or constituents to protect the designated use. Id. For waters with multiple use designations, the criteria shall support the most sensitive use. Id. In addition, the EPA's regulations require that in establishing criteria, a state shall consider WQS of downstream waters and shall ensure that its WQS provide for the attainment and maintenance of WQS of downstream waters. See 40 C.F.R. § 131.10(b).

A state's submission of water quality criteria must include (1) the methods used and analyses conducted to support WQS revisions, (2) water quality criteria sufficient to protect the designated uses, and (3) a certification by the State Attorney General or other appropriate legal authority within the state that the WQS were duly adopted pursuant to state law. See 40 C.F.R. § 131.6.

Endangered Species Act Requirements

In addition to the EPA's review pursuant to section 303 of the CWA, section 7(a)(2) of the Endangered Species Act (ESA) requires federal agencies, in consultation with the Fish and Wildlife Service (FWS) and, where applicable, the National Marine Fisheries Service, to ensure that their actions are not likely to jeopardize the continued existence of federally listed species or result in the destruction or adverse modification of designated critical habitat of such species.

With regard to consultation activities for section 7 of the ESA, the EPA Region 4 transmitted Biological Evaluations to the Jacksonville and Vero Beach FWS field offices in a letter dated February 10, 2015. The EPA received concurrence from the Vero Beach, FL FWS office in a letter dated April 27, 2015, and the Jacksonville, FL FWS office in a letter dated April 21, 2015.

Florida's New and Revised Water Quality Standards Submission

In a letter dated June 13, 2012, from Thomas M. Beason, General Counsel for FDEP, to Gwendolyn Keyes Fleming, Regional Administrator of the EPA's Region 4 Office, FDEP submitted section 62-302.531, F.A.C. titled Numeric Interpretations of Narrative Nutrient Criteria. Section 62-302.531[1] incorporated by reference a web link containing multiple H1 site specific numeric nutrient interpretations that further cross referenced to Chapter 62-304 TMDLs for various water bodies throughout the State of Florida. These H1s serve as the primary site specific interpretation of Florida's narrative water quality criterion for nutrients set out in paragraph 62-302.530(47)(b) in accordance with paragraph 62-302.531(2)(a). The General Counsel certified that the new or revised WQS revisions set out in section 62-302.531 were duly adopted pursuant to existing Florida law.

BACKGROUND

On June 13, 2012, FDEP submitted for review section 62-302.531, which incorporated by reference a web link containing several H1s administered through TMDLs for various waterbodies. Each H1 was cross referenced to a provision in Chapter 62-304 which sets out FDEP adopted TMDLs and includes additional details regarding the criteria.

On November 20, 2012, the EPA approved the underlying WQS language contained in section 62-302.531(2)(a) pursuant to section 303(c) of the CWA. Since that time, the EPA has approved several of the waterbody specific H1s listed in the web link at http://www.dep.state.fl.us/water/wqssp/swq-docs.htm (more directly accessed at this web link http://www.dep.state.fl.us/water/wqssp/docs/swqdocs/nutrient-tmdl-list.pdf) and cross referenced to Chapter 62-304. The status of each H1 contained in the web link at the date of this action is listed in the table below.

	Waterbody Name	WBID	FAC Rule Citation	Date and Action Taken
CE	Lake Wauberg	2741	62-304.500(9)	Approved by this action.
CE	Lake Yale Canal	2807	62-304.500(10)	Approved by this action.
CE	Lake Yale	2807A		

[1] Unless otherwise stated, all rule and subsection citations are to provisions in the Florida Administrative Code.

	Waterbody Name	WBID	FAC Rule Citation	Date and Action Taken
CE	Helena Run	2832	62-304.500(8)	Approved by this action.
CE	Little Lake Harris	2838B		
CE	Lake Harris	2838A		
CE	Lake Jesup	2981	62-304.505(1)	Approved by this action.
CE	Lake Jesup Near St. Johns River	2981A		
CE	Little Wekiva Canal	3004	62-304.506(6)	Approved by this action.
CE	Crane Strand Drain	3014	62-304.505(2)	Approved 1/14/14.
CE	Lake Griffin	2814A	62-304.500(7)	Approved by this action.
CE	Haynes Creek Reach	2817A	62-304.500(6)	Approved by this action.
CE	Lake Eustis	2817B		
CE	Trout Lake	2819A	62-304.500(15)	Approved by this action.
CE	Dora Canal	2831A	62-304.500(5)	Approved by this action.
CE	Lake Dora	2831B		
CE	Lake Beauclair	2834C	62-304.500(4)	Approved by this action.
CE	Lake Apopka, Lake Apopka Outlet, and Gourd Neck Spring	2835B	62-304.500(3)	Approved by this action.
CE	St. Johns River above Lake Poinsett	2893L	62-304.510(1)	Approved 6/21/13.
CE	Lake Hell'n Blazes	2893Q	62-304.510(2)	
CE	St. Johns River above Sawgrass Lake	2893X	62-304.510(3)	
CE	Wekiva River	2956 2056A	62-304.506(2) & (3)	Approved by this action.
CE	Wekiwa Spring (Orange)	2956C	62-304.506(1)	Approved by this action.
CE	Indian River Above Sebastian Inlet	2963A	62-304.520(7)	Approved 7/29/13.
CE	South Indian River	5003D		
CE	Indian River Above Melbourne Causeway	2963B 2963C	62-304.520(6)	
CE	Indian River Above 520 Causeway	2963D	62-304.520(5)	
CE	Indian River Above NASA Causeway	2963E	62-304.520(4)	
CE	Indian River Above Max Brewer Causeway	2963F	62-304.520(3)	
CE	Spring Lake	2987A	62-304.506(8)	Approved by this action.
CE	Lake Florida	2998A	62-304.506(9)	

	Waterbody Name	WBID	FAC Rule Citation	Date and Action Taken
CE	Lake Orienta	2998C	62-304.506(10)	Approved by this action.
CE	Lake Adalaide	2998E	62-304.506(11)	
CE	Lake Lawne	3004C	62-304.506(12)	
CE	Silver Lake	3004D	62-304.506(13)	
CE	Bay Lake	3004G	62-304.506(14)	
CE	Newfound Harbor	3044A	62-304.520(11)	Approved 7/29/13.
CE	Banana River Below 520 Causeway	3057A 3057B	62-304.520(10)	
CE	Banana River Above Barge Canal	3057C	62-304.520(9)	
CE	Central and southern South Indian River	5003B 5003C	62-304.520(8)	
CE	St. Johns River above Wekiva River	2893C	62-304.505(13)	Approved 6/21/13.
CE	Lake Monroe	2893D	62-304.505(12)	
CE	St. Johns River above Lake Monroe	2893E		
CE	St. Johns River downstream of Lake Harney and above Lake Jesup	2893F 2964	62-304.505(14)	
CE	Lake Harney	2964A	62-304.505(7)	
CE	Long Branch	3030	62-304.505(4)	Withdrawn by State.
CE	Rock Springs and Rock Springs Run	2967	62-304.506(4) & (5)	Approved by this action.
CE	Smith Canal	2962	62-304.505(10)	Approved 1/17/14.
CE	Lake Carlton	2837	62-304.500(17)	Approved by this action.
CE	Spruce Creek	2674A	62-304.435(2)	Withdrawn by State
NE	Newnans Lake	2705B	62-304.500(11)	Approved by this action.
NE	Orange Lake	2749A	62-304.500(12)	Approved by this action.
NE	Alachua Sink	2720A	62-304.500(19)	Approved 3/12/13.
NE	St. Johns River above Mouth	2213A	62-304.415(2)	Approved 6/21/13.
NE	St. Johns River above ICWW	2213B		

	Waterbody Name	WBID	FAC Rule Citation	Date and Action Taken
NE	St. Johns River above Dames Point	2213C	62-304.415(2)	Approved 6/21/13.
NE	St. Johns River above Warren Bridge	2213E		
NE	St. Johns River above Piney Point	2213F		
NE	St. Johns River above Black Creek	2213I	62-304.415(1)	Approved 6/21/13.
NE	St. Johns River above Palmo Creek	2213J		
NE	St. Johns River above Tocio	2213K		
NE	St. Johns River above Federal Point	2213L		
NE	St. Johns River above Rice Creek	2213M		
NE	St. Johns River above Dunns Creek	2213N		
NE	Suwannee River (Lower)	3422 3422A 3422B	62-304.405(1)(a)	Approved 7/3/13.
NE	Lower Suwannee Estuary	3422D	62-304.405(2)(c)	
NE	Manatee Springs	3422R	62-304.405(2)(b)	
NE	Fanning Springs	3422S	62-304.405(2)(a)	
NE	Branford Springs	3422J	62-304.405(1)(b)	
NE	Ruth Spring	3422L	62-304.405(1)(c)	
NE	Troy Springs	3422T	62-304.405(1)(f)	
NE	Royal Springs	3422U	62-304.405(1)(d)	
NE	Falmouth Springs	3422Z	62-304.405(1)(b)	
NE NE	Santa Fe River	3605A 3605B 3605C	62-304.410(1)	Approved 7/3/13.
NE	Arlington River	2265A	62-304.415(26)	Withdrawn by State
NE	Mill Creek	2460	62-304.415(37)	Withdrawn by State
SW	Lake Lulu	1521	62-304.625(5)	Approved by this action.
SW	Lake Shipp	1521D	62-304.625(8)	Approved by this action.
SW	Lake May	1521E	62-304.625(6)	
SW	Lake Howard	1521F	62-304.625(2)	
SW	Lake Mirror	1521G	62-304.625(7)	
SW	Lake Cannon	1521H	62-304.625(1)	
SW	Lake Idylwild	1521J	62-304.625(3)	
SW	Lake Jessie	1521K	62-304.625(4)	
SW	Thirty Mile Creek	1639	62-304.605(1)	Withdrawn by State
SW	Lake Hunter	1543A	62-304.610(4)	Approved by this action.

	Waterbody Name	WBID	FAC Rule Citation	Date and Action Taken
SW	Rattlesnake Slough	1923	62-304.615(7)	Withdrawn by State.
NW	Little Gully Creek	1039	62-304.310(3)	Withdrawn by State.
NW	Minnow Creek	130	62-304.325(5)	Approved 1/17/14.
NW	Sikes Creek	142	62-304.325(7)	
SO	Caloosahatchee Estuary (Tidal Segment 1)	3240A	62-304.800(2)	Approved 7/3/13.
SO	Caloosahatchee Estuary (Tidal Segment 2)	3240B		
SO	Caloosahatchee Estuary (Tidal Segment 3)	3240C		
SO	Lake Trafford	3259W	62-304.810(2)(c)	Withdrawn by State.
SE	St. Lucie Estuary	3193	62-304.705(1)	Approved 7/3/13.
SE	North Fork St. Lucie River (freshwater)	3194	62-304.705(2)	
SE	North Fork St. Lucie River (estuarine north fork)	3194B	62-304.705(3)	
SE	C-24 Canal	3197	62-304.705(4)	
SE	C-23 Canal	3200	62-304.705(5)	
SE	South Fork St. Lucie Estuary	3210	62-304.705(6)	
SE	South Fork St. Lucie River	3210A	62-304.705(7)	
SE	Bessey Creek	3211	62-304.705(8)	
SE	C-44 Canal	3218	62-304.705(9)	
SE	Pompano Canal	3271	62-304.726	Withdrawn by State

EPA'S DECISION

Each of FDEP's site specific numeric nutrient criteria and/or loadings for total nitrogen (TN) and/or total phosphorus (TP) approved by this action are listed below by waterbody name. Any other criteria applicable to these waterbodies remain in effect. Especially, specific to nutrients, (1) the chl *a* criterion value of 20 µg/L annual geometric mean for lakes with a color value greater than 40 platinum cobalt units (PCU) and lakes with a color value less than or equal to 40 PCU and less than 20 mg/L $CaCO_3$, or (2) the chl *a* criterion value of 6 µg/L annual geometric mean, for lakes with a color value less than or equal to 40 PCU and less than or equal to 20 mg/L $CaCO_3$ continues to apply. In addition, if an H1 did not establish waterbody specific NNC for TN or TP the default values contained in paragraph 62-302.531(2)(b)1. continue to apply.

In addition, paragraph 62-302.530(47)(a) continues to apply to these waterbodies. Paragraph 62-302.530(47)(a) provides that "[t]he discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Rules 62-302.300, 62-302.700, and 62-4.242, F.A.C.".

Technical Approaches Used to Derive Numeric Nutrient Criteria

The State used several technical approaches or lines of evidence to derive numeric nutrient criteria and/or loadings for the waterbodies addressed by this approval. This decision document is arranged to first describe a technical approach, followed by the waterbodies that are being approved based on that technical approach.

1. Trophic State Index to Derive TN and TP Approach

The TN and TP loadings and/or concentrations for several lakes addressed by this decision were derived using a referenced based approach using data from 34 reference lakes across the State of Florida to show that the Tropic State Index (TSI) of lakes with minimum human impact vary naturally within a specified range. For the analysis, only lakes that had a land use area weighted average watershed Land Disturbance Index score less than 3.0 were used to calculate the long term mean annual average TSI. The lakes were also divided into groups of high color (greater than 40 PCU) and low color (less than or equal to 40 PCU). The results of the analysis indicated that the 25th percentile of the distribution of standard deviation for both lake categories is approximately 5 TSI units, demonstrating that adding 5 TSI units to the modeled background TSI is within the low end of the range for natural TSI variation in lakes across Florida. The final calculated number (modeled background TSI plus 5 TSI units) represents the natural background TSI value.

More broadly applied, one measure of impairment in lakes set out in the Impaired Waters Rule is a 10 unit change in TSI from "historical" levels. This 10 unit increase is assumed to represent the transition of a lake from one trophic state (e.g., mesotrophic) to another nutrient enriched condition (e.g., eutrophic). FDEP's analysis for criteria development, outlined above, determined that an increase in 5 TSI units would not result in a lake changing its trophic state. Based on that analysis, background value plus 5 TSI units represent the final TSI value used to derive TN and/or TP loadings and/or concentrations for each lake.

EPA Analysis

The EPA determined that the various modeling approaches used by the State to determine natural background TSI are appropriate and defensible methods and that the addition of TSI units to modeled natural background TSI values, as calculated by the State, is also a reasonable and appropriate approach for the lakes addressed by this approval action. This approach is further supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized above. The TN and TP loadings and/or concentrations derived from TSI values that constitute natural background plus additional TSI units to account for natural variability as presented in each waterbodies' TMDL, represent levels at which a balance in flora and fauna will occur and are therefore protective of the lakes' designated uses and downstream waters.

More detail is set out below, describing how FDEP applied the TSI method to derive TN and TP for the following waterbodies: Lake Jesup, Lake Jesup Near St. Johns River, Trout Lake, Wekiva Lakes (Spring Lake, Lake Florida, Lake Orienta, Lake Adalaide, Lake Lawne, Silver Lake and Bay Lake) and Lake Hunter.

a. Lake Jesup and Lake Jesup Near St. Johns River

Lake Jesup, located in central Florida, has a surface area of about 10,660 acres (16.7 square miles) and drains a watershed of about 87,331 acres (136.5 square miles) to the St. Johns River on the northeast side of the Middle St. Johns Basin. The majority of the watershed lies within Seminole County, but a small portion on the southwest end extends into Orange County. The lake is low lying, with an average stage of about 1.86 feet National Geodetic Vertical Datum (NGVD). Lake elevations tend to follow the water surface elevations of the St. Johns River at its confluence with Lake Jesup. When local rainfall is lower than regional rainfall (particularly to the south), the river rises, and water flows from the St. Johns River into the lake (Keesecker, 1992). Surface runoff discharges into Lake Jesup primarily through three tributaries Howell Creek, Gee Creek, and Soldier Creek that are located to the south and southwest of the lake.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Jesup	2981	Lake Class III Freshwater	Nutrients (TSI)	62-304.505(1) "The Total Maximum Daily Load for Total Nitrogen (TN) is 247.3 tons/year" and "The Total Maximum Daily Load for Total Phosphorus (TP) is 19.0 tons/year."	TP = 19.0 tons/yr., TN = 247.3 tons/yr., Not to be exceeded at any time.
Lake Jesup Near St. Johns River	2981A				

To establish the TSI target, FDEP first estimated the background TSI for the lake by comparing results from several methods, including a historic sedimentation rate method, literature published values, a TSI defined by the Florida Impaired Waters Rule, an Ecoregion approach, a hydrogeomorphologic method, and a model-simulated background condition. Results from these different methods all converged on a TSI of 60. To allow for natural variability, 5 TSI units were added to the estimated background TSI, resulting in a TSI value of 65 for Lake Jesup.

Nutrient loads from the watershed were simulated using a watershed pollutant loading model developed by a contractor. This model is based on the Soil Conservation Service curve number approach, which takes into consideration the landuse, soil, and antecedent moisture condition of the soil in simulating the watershed loads. Nutrient loads from other sources, including groundwater input through baseflow and artesian flow, loading from septic tanks, atmospheric deposition directly on to the lake surface, and nitrogen fixation were also considered.

Estimates of nutrient loads from all these sources were entered into the Bathtub eutrophication model to estimate in lake TN, TP, and chl *a* concentrations, and model calibration was conducted through fitting model simulated concentrations with measured results. The Bathtub eutrophication model estimates nutrient concentrations and algal biomass resulting from different patterns of nutrient loadings. The watershed nutrient loads that resulted in existing TN, TP, and chl *a* concentrations were considered the existing nutrient loads. To estimate the nutrient TMDL, nutrient loads from different sources were adjusted using the calibrated contractor Bathtub model suite until the target TSI was achieved. The nutrient loads that resulted in the target TSI were considered the TMDL. That TMDL is also the H1 criteria.

b. Trout Lake

Trout Lake is located in central Lake County near Eustis in the Hicks Ditch watershed. The Lake has a surface area of about 102 acres (Florida Lake Watch) and a mean depth of about 9 feet (St. John River Water Management District [SJRWMD], 1996). A stream (Hicks Ditch) northeast of the lake collects surface runoff from the majority of the Hicks Ditch watershed and discharges into the lake. Trout Lake has a single major surface water outlet, which discharges into Lake Eustis.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Trout Lake	2819A	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(15) " The Total Maximum Daily Load for Trout Lake for Total Nitrogen (TN) is 9,733 pounds per year (lbs/y)" and "The Total Maximum Daily Load for Total Phosphorus (TP) for Trout Lake is 521 lbs/y"	TP = 521 lbs/yr TN = 9,733 lbs/yr Not to be exceeded at any time.

TN and TP loadings from various sources in the watershed were first estimated using the Watershed Management Model (WMM). Loading estimates from the WMM were then entered into the Bathtub eutrophication model to establish a relationship between TN and TP loadings and in lake TN, TP, and chl *a* concentrations.

The model results for in lake TN, TP, and chl *a* were used to calculate TSI values for two different loading scenarios. One scenario was to calculate the TSI for current conditions. Another scenario was to calculate the TSI for natural background. Under the natural background scenario, the loadings from all human activities were removed in the model. The calculated TSI from the latter scenario was considered as the natural background TSI of Trout Lake; this natural background TSI was predicted to be 49, and 5 TSI units were added resulting in a TSI of 54. TSI nutrient loading curves were developed for TN and TP based on a TSI value of 54 which generated an annual TMDL load of 9,733 lbs/year for TN and 521 lbs/year for TP.

c. Wekiva Lakes (Spring Lake, Lake Florida, Lake Orienta, Lake Adalaide, Lake Lawne, Silver Lake, and Bay Lake)

The boundary of the Wekiva Lakes Study Area (WSA) encompasses 473 square miles, located in central Florida and includes portions of the northeastern part of Lake County, western part of Seminole County, and northwestern part of Orange County. Three of the seven lakes including Lake Lawne, Bay Lake, and Silver Lake, are located in the southeastern corner of the WSA, which is part of Orange County and City of Orlando. The remaining four lakes (Spring Lake, Lake Florida, Lake Orienta, and Lake Adelaide) are located along the eastern boundary of the WSA, which is in the western part of Seminole County, City of Altamonte Springs, and western part of Longwood.

Except for Lake Lawne, the lakes are located in the Orlando Ridge region which is an urbanized karst area of low relief, with elevations from 75-120 feet. Phosphatic sands and clayey sand are at a shallow depth. Lakes in this region can be characterized as clear, alkaline, hard-water lakes of moderate mineral content. Most of the lakes located in this region are mesotrophic to eutrophic. Lake Lawne is located in the Apopka Upland area. This is a region of residual sand hills, modified by karst processes and contains many small lakes with general elevations ranging from 70 to 150 feet. The current land cover of the lake region consists of citrus, pasture, and urban and residential development. The physical and chemical characteristics of the lakes are varied, and lake water levels can fluctuate greatly throughout drought periods. There are some acidic, clear, softwater lakes of low mineral content; some clear lakes with moderate nutrients; and some darker water lakes that still have nearly neutral pH values.

Waterbody Name	**WBID**	**Description Class**	**Listing Parameter**	**Chapter 62-304 Language**	**Approved Loading Targets**
					Not to be exceeded at any time.
Spring Lake	2987A	Lake Class III Freshwater	Nutrients (TSI)	62-304.506(8) "The Total Maximum Daily Loads for Spring Lake are 8,551 lbs/year of total nitrogen and 641 lbs/year of total phosphorus"	TN = 8,551 lbs/year TP = 641 lbs/year
Lake Florida	2998A			62-304.506(9) "The Total Maximum Daily Loads for Lake Florida are 8,377 lbs/year of total nitrogen and 571 lbs/year of total phosphorus."	TN = 8,377 lbs/year TP = 571 lbs/year
Lake Orienta	2998C			62-304.506(10) "The Total Maximum Daily Loads for Lake Orienta are 6,092 lbs/year of total nitrogen and 451 lbs/year of total phosphorus."	TN = 6,092 lbs/year TP = 451 lbs/year
Lake Adalaide	2998E			62-304.506(11) "The Total Maximum Daily Loads for Lake Adelaide are 3,003 lbs/year of total nitrogen and 228 lbs/year of total phosphorus."	TN = 3,003 lbs/year TP = 228 lbs/year
Lake Lawne	3004C			62-304.506(12) "The Total Maximum Daily Loads for Lake Lawne are 21,692 lbs/year of total nitrogen and 2,005 lbs/year of total phosphorus."	TN = 21,692 lbs/year TP = 2,005 lbs/year
Silver Lake	3004D			62-304.506(13) "The Total Maximum Daily Loads for Silver Lake are 6,241 lbs/year of total nitrogen and 370 lbs/year of total phosphorus."	TN = 6,241 lbs/year TP = 370 lbs/year
Bay Lake	3004G			62-304.506(14) "The Total Maximum Daily Loads for Bay Lake are 1,428 lbs/year of total nitrogen and 109 lbs/year of total phosphorus."	TN = 1,428 lbs/year TP = 109 lbs/year

FDEP developed a TSI target on which to base TN and TP reductions for these seven lakes. The TSI target was based on a 5 unit TSI increase over background conditions to allow for natural variability of the lakes while protecting against significant changes in trophic status. To derive the background conditions on which the TSI target was based, FDEP first utilized the WMM to estimate existing loading from the watershed (including surface runoff, baseflow and septic tanks). Then these loadings, coupled with atmospheric deposition load estimates and best management practice nutrient reductions were entered into the Bathtub model and calibrated with water quality monitoring data to define the relationship between TN and TP loading and in lake TN, TP, and chl *a* concentrations. Contributions from groundwater were assumed to be negligible based on a flow analysis and corroborating potentiometric head evidence. Model simulations were then run with loadings adjusted to represent natural background conditions. Natural background conditions were simulated by setting all human land uses to forest/rural open land use and setting septic tank contributions to zero, while atmospheric deposition and baseflow were unchanged. As stated above, the resulting TSI from the natural background condition run was increased by 5 TSI units to account for natural variability.

The modeling output outlined above, calculated TSI levels for each lake as follows:

Lake Name	Background TSI	Target TSI
Spring Lake (2987A)	49	54
Lake Florida (2998A)	44	49
Lake Orienta (2998C)	49	54
Lake Adalaide (2998E)	51	56
Lake Lawne (3004C)	55	60
Silver Lake (3004D)	38	43
Bay Lake (3004G)	43	48

Concentrations of TN, TP, and chl *a* corresponding to the target TSI were determined and each lake TMDL was expressed as the TN and TP loads required to meet the TSI target for each lake TMDL outlined in the table above. Those loads represent the H1 criteria for each lake.

d. <u>Lake Hunter</u>

Lake Hunter is a small freshwater body with a surface area of approximately 93.4 acres located inside Lakeland, Florida, in Polk County in the Hillsborough River basin. The Hillsborough River basin encompasses nearly 700 square miles, flowing southwest across portions of Hillsborough, Pasco, and Polk counties and terminating at Tampa Bay. Land use in the basin is approximately 39 percent undeveloped and natural lands, including swamps and forested uplands, and 25 percent urban and industrial land, including the Tampa, Plant City, and Lakeland areas. Lake Hunter covers a surface area of approximately 93.4 acres and has an average depth of 6 feet. The area draining into Lake Hunter is approximately 611 acres, of which roughly 61 percent is residential and 27 percent is urban and built-up. There are no permitted wastewater treatment facilities or tributaries that discharge to the Lake Hunter drainage basin. The majority of flow into the lake is from direct surface runoff and from stormwater discharges piped into Lake Hunter from two neighboring lakes (Lakes Beulah and Wire). Seepage from Lake Hunter to groundwater appears to fluctuate in direct response to the amount of inflow from Lakes Beulah and Wire. Lake Hunter discharges through a double gate to an unnamed creek.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Hunter	1543A	Lake Class III Freshwater	Nutrients (TSI)	62-304.610(4) "(4) The Total Maximum Daily Load for Lake Hunter is an annual average load of 6,579 pounds/year of total nitrogen and 489 pounds/year of total phosphorus."	TP = 6,579 lbs/yr TN = 489 lbs/yr Not to be exceeded at any time.

A maximum annual TSI target of 63 was established based upon a TSI level that is 5 units above the simulated natural background TSI to account for natural variability. To determine TN and TP loading endpoints that correspond to the target TSI, all existing nonpoint source contributions were modeled in a spreadsheet model using equations from WMM, except for septic tanks and groundwater where the modeling methods of Haith, Mandel, and Wu were used. Additional factors were considered including atmospheric deposition using National Oceanic and Atomospheric Administration rainfall records, and sedimentation using the Vollenweider and bathtub models. A natural background TSI of 57.5 (58) that represents a natural condition scenario was estimated using the meteorological conditions of 1991, the year with the "best-case" condition (10^{th} percentile TSI from 1989-2002). To determine the TMDL, simulated nutrient contributions were reduced until the annual TSI of the year (2001) with the "worst-case" condition (90^{th} percentile TSI from 1989-2002) was reduced below the target TSI of 63. The TMDL conditions corresponding to the TSI target were determined to be loads of 6,579 lbs/yr for TN and 489 lbs/yr for TP. These loads represent the H1 criteria for the lake.

2. Fulton Lakes Study

FDEP examined multiple lines of evidence to derive TP NNC as annual loadings for several lakes listed below. Specifically, the proposed TP loading values for the lakes were derived from the report titled "Interim Pollutant Load Reduction Goals for Seven Major Lakes in the Upper Ocklawaha River Basin (UORB)" Fulton et al. 2003. An updated study named "Pollutant Load Reduction Goals for Seven Major Lakes in the Upper Ocklawaha River Basin" Technical Publication SJ2004-5 Fulton et al. 2004 was published in 2004.

Two approaches were used to estimate historic phosphorus concentrations in the UORB lakes: modeling of external loading and water quality under historic conditions and the use of regional lakes representing reference conditions. The State also attempted to determine historic phosphorus concentrations in the UORB lakes using diatom microfossils in the lake sediments; however, they found this evidence to be unreliable and discounted the findings for use in deriving historic TP.

To develop the nutrient loadings, the State first estimated the natural background phosphorus concentration for the lakes through a combination of modeling the historic conditions in the basin and using existing concentrations in reference lakes. Four variations of a mass balance model (Vollenweider and Kerekes 1980), which treats a lake as a continuously stirred tank reactor, with phosphorus inflows, outflows, and losses to the sediments and predicts concentrations of phosphorus at a steady state were used. These models were applied to predict phosphorus concentrations for the existing hydrology and nutrient loading for the 5 year period from 1986 to 1990. The model that best predicted the reported phosphorus concentrations for that period was applied to the estimates of phosphorus loading under natural background conditions. The application of the model predictions to natural background conditions assumes that the natural background conditions were similar to existing conditions, except for nutrient loading. Natural background phosphorus loading was estimated by: 1) using a phosphorus concentration for discharges into the basin from upstream Lake Apopka of 40 μg/L, the midpoint of the most probable range of antecedent conditions determined for that lake (Lowe et al. 1999), 2) converting all existing land uses in the basin to either forest/rangeland or wetlands for estimating stormwater runoff from within the watershed, and 3) eliminating all point source and septic tank discharges. The model predictions were then adjusted to account for errors in the predicted phosphorus for the same period.

For reference conditions, the natural, least impacted, condition for lakes in the region that were determined to be geologically or geographically similar to the UORB lakes were used. Three reference condition data sets were used 1) a detailed ecoregional map developed for Florida lakes by the EPA and the Florida Lake watch program, 2) a data set for ecoregions within the SJRWMD assembled by John Hendrickson (SJRWMD, unpublished); and 3) lakes with similar morphology and hydrology to the UORB lakes. The two ecoregional approaches were averaged to provide an estimate of historic phosphorus concentrations from geologically and geographically similar lakes.

Next, data collected from the UORB lakes between 1998 and 2001 were analyzed to determine the relationship between phosphorus concentrations and water transparency (compensation point). The State developed TP values using the transparency water quality standard for submerged aquatic vegetation through a "composite historic TP estimate" by averaging several conservative methods to estimate natural background TP.

The proposed TP loading targets were then developed using the existing WQS for water transparency published in Chapter 62-302.530(67), stated as: "Depth of the compensation point for photosynthetic activity shall not be reduced by more than 10% as compared to the natural background value." A regression analysis was used to relate data on phosphorus and water transparency (measured as light extinction coefficient). The compensation depth was determined from the extinction coefficient using the Lambert-Beer equation. A 10% reduction in the compensation depth corresponds with a 13% increase in phosphorus concentration.

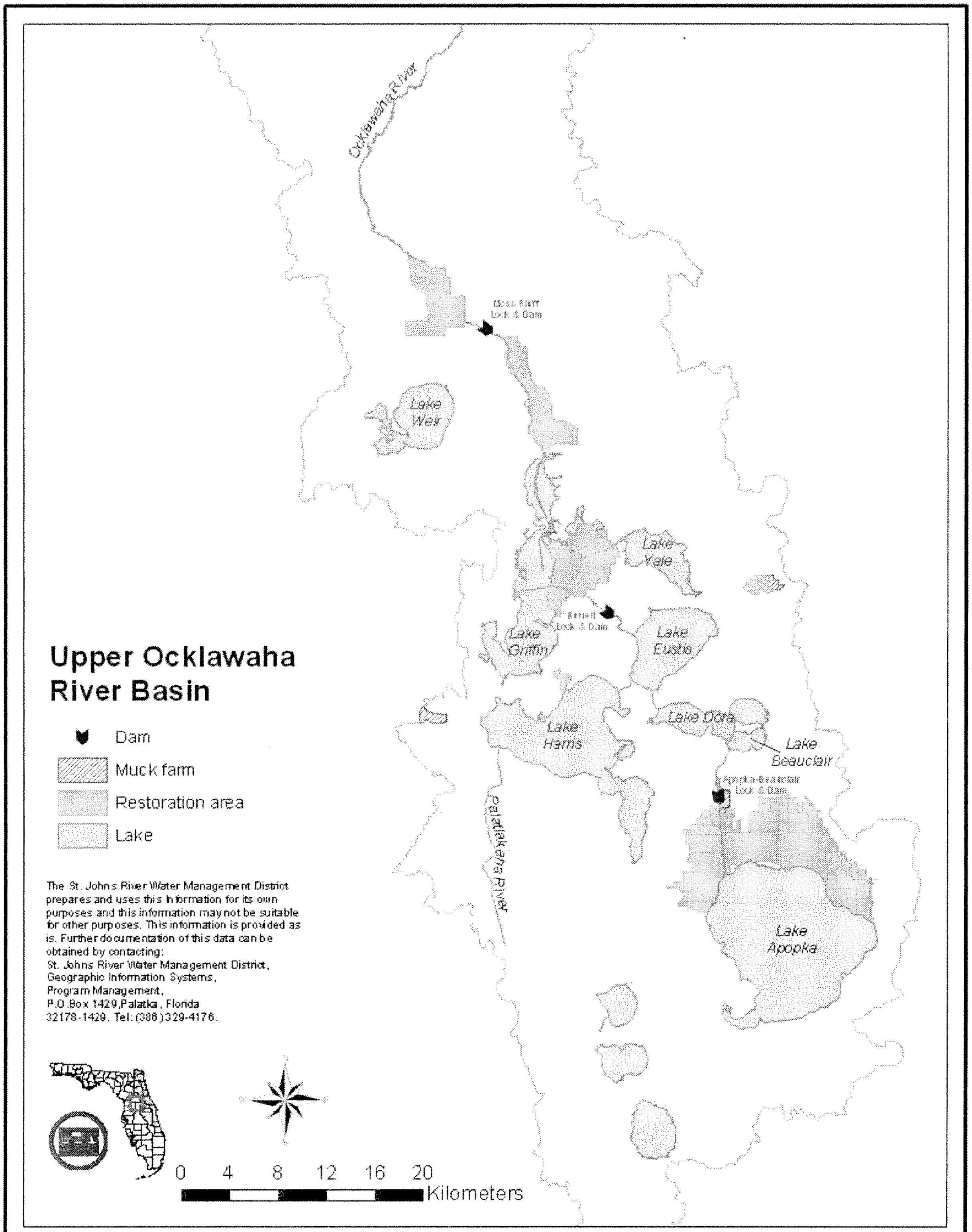
Therefore, the recommended phosphorus criterion for the interim Pollutant Load Reduction Goal (PLRG) for the UORB lakes allows a TP concentration that is 13% greater than the estimated natural background TP concentration in the lakes. Under the proposed target phosphorus concentrations, transparency for these lakes is expected to improve, thereby improving conditions for submerged aquatic vegetation. Estimated depths to which submerged aquatic vegetation could persist in the UORB lakes under existing conditions and at proposed target phosphorus concentrations/loadings were determined by assuming the compensation depth for aquatic vegetation occurs at 10% of surface illumination. A regression analysis of data on phosphorus and water transparency (measured as light extinction coefficient) collected from the UORB lakes between years 1998-2001 was used to predict the light extinction at existing (mean for years 1991–2000) and proposed target phosphorus concentrations. This 13% increase above natural phosphorus concentrations/loadings is predicted to restore designated uses and maintain water quality that would result in the balance of flora or fauna. The loadings reflect the long-term reductions needed to achieve designated uses, and are expressed as average annual loads.

EPA Analysis

FDEP used two approaches to derive TP loads for the UORB lakes. The first approach involved modeling both the external loading and resulting lake water quality under historic (natural background) conditions. For the second approach, an appropriate TP target was determined using reference conditions from lakes in the region based upon three estimates from the state lake ecoregion data, SJRWMD ecoregion dataset, and a selection of lakes with similar morphology and hydrology. It is standard practice to use a reference condition approach using water quality data from waterbodies with similar morphology and hydrology that are currently meeting their designated uses to derive a criteria and/or load for the waterbody of interest, with the belief that if the same water quality conditions are met in the waterbody of interest, then designated uses will be protected. Both of these methods relied upon information and/or relationships developed from long-term datasets or steady state conditions. The target concentration for each UORB lake that was used to derive the TP loading calculations is consistent with numeric interpretations for TP contained in 62-302.531(2)(b)1. and will provide for the balance of flora and fauna. The EPA has historically opined and also determined here that the mechanistic modeling and reference condition approaches that were used to derive TP loadings for these lakes are standard, acceptable approaches and are appropriate for use in ensuring the protection of water quality and aquatic life.

More detail is set out below that describes how FDEP applied the methods contained in the Fulton Lakes Study to derive TP for the following waterbodies: Lake Yale Canal, Lake Yale, Helena Run, Little Lake Harris, Lake Harris, Lake Griffin, Haines Creek Reach, Lake Eustis, Dora Canal, Lake Dora, Lake Beauclair and Lake Carlton. In addition, the H1s for these waterbodies did not establish specific NNC for TN, so the default values contained in paragraph 62-302.531(2)(b)1. continue to apply.

Upper Ocklawaha River Basin



a. Lake Yale Canal and Lake Yale

Lake Yale, located in central Florida approximately 30 miles northwest of Orlando, is part of the UORB. It has a drainage basin of approximately 15,394 acres (Fulton et al., 2003). At a lake surface elevation of 59 feet NGVD, the lake has a surface area of approximately 4,020 acres and an average depth of 12.2 feet. Surface outflow from the lake is through the Yale Canal into Lake Griffin. Discharge and water elevation is partially controlled by a fixed crest weir.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Yale Canal	2807	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(10) "The combined TMDL for Total Phosphorus (TP) for Lake Yale and Lake Yale Canal is 2,844 pounds/year of TP."	TP = 2,844 lbs/yr Not to be exceeded at any time.
Lake Yale	2807A				

b. Helena Run, Little Lake Harris, and Lake Harris

Helena Run, Little Lake Harris and Lake Harris are located in the UORB located approximately 30 miles northwest of Orlando in central Florida. They have a combined surface area of approximately 18,689 acres and an average depth of 12 feet. Water levels in the lake are maintained by the Burrel Lock and Dam located on Haines Creek. They have a combined drainage basin of approximately 53,073 acres. Urban development within the UORB has been documented since the 1940s, and water quality has declined due to anthropogenic alterations such as construction of water control structures and channelization; and discharges from domestic, industrial, and agricultural wastes.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Little Lake Harris	2838B	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(8) "The combined TMDL for Total Phosphorus (TP) for Lake Harris, Little Lake Harris, and Helena Run is 18,302 pounds/year of TP."	TP = 18,302 lbs/yr. Not to be exceeded at any time.
Lake Harris	2838A				

c. Lake Griffin

Lake Griffin, located in central Florida approximately 30 miles northwest of Orlando, is part of the UORB and the headwater lake of the Ocklawaha River. It has a drainage basin of approximately 50,575 acres (Fulton et al., 2003). At a lake surface elevation of 59 feet NGVD, the lake has a surface area of approximately 9,412 acres and an average depth of 7.7 feet. Surface outflow from the lake is through the Moss Bluff Lock and Dam, which is operated by the SJRWMD in accordance with regulations prescribed by the U.S. Army Corps of Engineers to maintain water levels in Lake Griffin. The regulation schedule maintains an elevation range of 58 to 59.5 feet NGVD in Lake Griffin.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Griffin	2814A	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(7) "The Total Maximum Daily Load for Total Phosphorus (TP) for Lake Griffin is 26,901 pounds/year of TP."	TP = 26,901 lbs/yr. Not to be exceeded at any time.

d. Haines Creek Reach and Lake Eustis

Haines Creek Reach and Lake Eustis, located in central Florida approximately 30 miles northwest of Orlando, are part of the UORB. They have a drainage basin of approximately 27,878 acres (Fulton et al., 2003). At a lake surface elevation of 63 feet NGVD, the lake has a surface area of approximately 7,757 acres and an average depth of 11.4 feet. Both Lake Dora and Lake Harris discharge into Lake Eustis. Lake Eustis flows into Lake Griffin through Haines Creek. Surface elevations in Lakes Eustis, Harris, Dora, and Beauclair are controlled by the Burrel Lock and Dam located on Haines Creek and operated by the SJRWMD. The regulation schedule maintains an elevation range between 62 to 63.5 feet NGVD in Lake Eustis.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Hai[y]nes Creek Reach	2817A	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(6) "The Total Maximum Daily Load for Total Phosphorus (TP) for Lake Eustis is 20,286 pounds/year of TP."	TP = 20,286 lbs/yr. Not to be exceeded at any time.
Lake Eustis	2817B				

e. Dora Canal and Lake Dora

Lake Dora, located in central Florida approximately 30 miles northwest of Orlando, is part of the UORB. It has a drainage basin of approximately 11,418 acres (Fulton et al., 2003). At a lake surface elevation of 63 feet NGVD, the lake has a surface area of approximately 4,384 acres and an average depth of 9.8 feet. Surface outflow from the lake is through the Doral Canal into Lake Eustis. Surface elevations in Lakes Eustis, Harris, Dora, and Beauclair are controlled by the Burrel Lock and Dam located on Haines Creek that is operated by the SJRWMD.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Doral Canal	2831A	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(5) "The Total Maximum Daily Load for Total Phosphorus (TP) for Lake Dora and Dora Canal is 13,230 pounds/year of TP."	TP = 13,230 lbs/yr. Not to be exceeded at any time.
Lake Dora	2831B				

f. Lake Beauclair and Lake Carlton

Lake Beauclair, located in central Florida approximately 25 miles northwest of Orlando, is part of the UORB. It has a drainage area of approximately 9,296 acres (Fulton et al., 2003). At a lake surface elevation of 63 feet NGVD, the lake has a surface area of approximately 1,085 acres and an average depth of 6.7 feet. Surface outflow from the lake is to Lake Dora. Surface elevations in Lakes Eustis, Harris, Dora, and Beauclair are controlled by the Burrel Lock and Dam located on Haines Creek and operated by the SJRWMD.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Beauclair	2834C	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(4) "The Total Maximum Daily Load for Total Phosphorus (TP) for Lake Beauclair is 7,056 pounds/year of TP."	TP = 7,056 lbs/yr. Not to be exceeded at any time.
Lake Carlton	2837				

3. Miscellaneous Approaches

The State used individual technical approaches or lines of evidence to derive numeric nutrient criteria and/or loadings for the following waterbodies. All of these technical approaches are considered by the EPA to be defensible methods in which to derive TN and TP levels that will protect the balance of flora and fauna and protect the designated use. They are outlined separately below.

Paleoecological Trophic State Index Information Approach

The water quality model used to develop the TN/TP loads reflect the unique watershed and geological characteristics surrounding Lake Wauberg. The specific natural background condition TSI target for the lake was determined by the results of a paleoecological study conducted for Lake Wauberg. The watershed model estimated the natural background TSI and TN and TP loading targets. The pre-disturbance period, defined as before 1880, in the paleoecological study supports the final TSI value. All information indicated that the TSI is appropriate in considering the unique characteristics of the lake and range of appropriate TSI targets for lakes in Florida.

EPA Analysis

The EPA determined that the various modeling approaches used by the State to determine natural background TSI for Lake Wauberg are appropriate and defensible methods. This approach is supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized in the description of methodology 1. Trophic State Index to Derive TN and TP Approach, above.

The TN and TP loadings and/or concentrations in the Lake Wauberg TMDL were derived from TSI values that constitute natural background TSI units, to account for natural variability in the lake and represent levels at which a balance in flora and fauna will occur. The TMDL loadings protect the lake's designated uses and downstream waters. The paleoecological study that estimated pre-disturbance TSIs supports the Lake Wauberg TSI and pre-disturbance Chlorophyll levels and the final loads for TN of 2,062 lbs/yr and for TP of 374 lbs/yr.

Lake Wauberg

Lake Wauberg is located about eight miles south of Gainesville in Alachua County in the Ocklawaha River Basin. The lake has a mean depth of 12 feet and occupies about 235 acres in a watershed that covers approximately 717 acres which includes the lake. The lake is part of the Central Valley region, a low area with generally flat to gently rolling terrain underlain by a layer of predominantly sandy soils overtop a limestone bedrock. Average annual rainfall to the Central Valley is about 51 inches, over half of which occurs between June and September. It is estimated that annual evapotranspiration for this watershed can range from 41-45 inches annually, with the remaining rainfall either recharging groundwater or resulting in surface runoff. Direct rainfall and surface and subsurface runoff are the primary sources of water to the lake. Lake Wauberg represents 32.9 percent of the watershed. The remainder of the watershed is largely forested (38.3%) with only a small portion of the watershed characterized by agriculture (11.1%) or development (5.5%).

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Wauberg (Outlet)	2741	Lake Class III Freshwater	Nutrients (TSI)	62-304.500(9) "The Total Maximum Daily Load for Lake Wauberg for Total Phosphorus is 374 lbs/yr and for Total Nitrogen is 2,062 lbs/yr"	TP = 374 lbs/yr TN = 2,062 lbs/yr Not to be exceeded at any time.

The water quality model used to develop the TMDL estimated the annual average natural background TSI and the TMDL TN and TP loading targets for Lake Wauberg. The unique characteristics of the watershed were considered in the model and included the following: 1) the floor of the lake is directly connected to the Hawthorne formation, which has naturally high phosphorus levels, 2) the lake has an outflow only in wet years, and 3) the lake has a very low drainage area to lake area ratio. The watershed model showed that precipitation directly onto the surface of the lake represents 65 percent of the total annual water budget for the lake. The TSI values obtained from the paleoecological study (Whitmore and Brenner 2002) for Lake Wauberg estimated pre-disturbance TSIs ranging between 62 and 65. The study also showed that Lake Wauberg is not typical, in that the further back in time (lower in the core), the higher the TP and chlophyll concentrations. The authors concluded that the lake is controlled more by soil and geologic factors than watershed loading and that changes in hydrology and landuse over time may have resulted in a slight decrease of trophic state. The study concluded that, based on the lowest two core depths, the inferred pre-disturbance TN and TP concentrations corresponded with a TSI of 60 as well as the lower pre-disturbance chlophyll levels. The final loads for TN of 2,062 lbs/yr and TP of 374 lbs/yr are reflective of natural background conditions and are supported by the paleoecological study.

Ecological Efficiency, Algal and Periphyton Community Studies Approaches

The nitrate and TP targets for Wekiva Spring were determined considering historical and reference stream conditions and scientific studies that analyzed levels of nitrate and TP corresponding to flora and fauna health. The ecological efficiency target study evaluated the ecosystem-level property that estimated the overall efficiency of the aquatic ecosystem to utilize incident solar radiation. This approach provided the TP target for the spring system. The TP target was also based on the algal species composition study that determined the TP concentration that would not result in unhealthy increases of percent green and blue-green algal components in the benthic algal communities. A periphyton biomass (cell density) study analyzed the correlation between nitrate and periphyton to determine a protective nitrate concentration.

EPA Analysis

The EPA determined that the use of historical and reference stream data to determine nutrient concentrations protective of flora and fauna are appropriate and defensible methods. The nitrate and TP concentrations were determined from the ecological efficiency target study and the correlation between nitrate and periphyton biomass/cell density. The TP target was based on the algal species composition study that determined appropriate percent green and blue-green algal components in the benthic algal communities. In addition to the scientific approaches used in this TMDL, the nitrate and TP concentrations are applied in a conservative manner, (e.g. monthly rather than annual averages). The final nutrient concentrations were developed to prevent dominance of unhealthy algal species, optimize ecological efficiency of the aquatic ecosystem, and maintain healthy periphyton biomass. These approaches represent nitrate and TP levels at which a balance in flora and fauna were demonstrated to occur.

More detail is set out below that describes how FDEP applied the Ecological Efficiency, Algal and Periphyton Community Studies Approaches method to derive TN and TP for the following waterbodies: Wekiva River, Wekiva Spring (Orange), and Rock Springs Run.

Wekiva Spring

The Wekiva River Basin is a complex ecological system of rivers, springs, seepage areas, lakes, streams, sinkholes, wetland prairies, hardwood hammocks, pine flatwoods, and sand pine scrub communities. The Wekiva River and Rock Springs Run (a second magnitude spring that feeds into the Wekiva River) are located in the Middle St. John's River Basin in Orange County, Florida and are designated as a Class III Outstanding Florida Water and a National Wild and Scenic River, respectively. The Wekiva River is approximately 67 percent spring-fed (from the Rock Springs Run), reaches approximately 16 miles north of Orlando and northeast of Apopka, and flows northward to the confluence with the St. John's River. The remaining waters that feed into the Wekiva are blackwater streams which receive the majority of their flow from precipitation. The Wekiva River ranges from 50 feet to 300 feet wide.

Waterbody Name	**WBID**	**Description Class**	**Listing Parameter**	**Chapter 62-304 Language**	**Approved Loading and Concentration Targets**
Wekiva River	2956 2956A	Class III Outstanding Florida Water (OFW) Freshwater Stream/Spring	Nutrients	62-304.506(1) Wekiva Spring, (2) Wekiva River upstream,(3) Wekiva River downstream, (4) Rock Springs, (5) Rock Springs Run "The Total Maximum Daily Loads for Wekiwa Spring are to	Nitrate = 0.286 mg/L Monthly average not to be exceeded at any time. TP = 0.065 mg/L Monthly average not to be exceeded at any time.
Wekiva Spring (Orange)	2956C				
Rock Springs Run	2967	Class III (OFW) Freshwater Spring	Nutrients		

				achieve 0.286 mg/L nitrate and 0.065 mg/L total phosphorus"	

In developing the nutrient targets in this TMDL, historical data were collected, reference stream values were examined, and several studies were conducted and/or referenced to analyze levels of nitrate that correspond with imbalanced flora and fauna. The State developed target nitrate and TP concentrations considering information based on an ecological efficiency target. Ecological efficiency is an ecosystem-level property that estimates the overall efficiency of an aquatic ecosystem to utilize incident solar radiation and in this case had the highest significant functional relationship with nutrient concentrations. The target nitrate concentration of 0.286 mg/L was derived from an analysis based on correlation between nitrate and periphyton biomass or cell density. The TP target was established based on the algal species composition study conducted by the SJRWMD. The study determined that TP concentrations above 90 μg/L caused significant increases of percent green and blue-green algal components in the benthic algal communities and noted an inverse relationship between the ecological efficiency and TP concentration.

Modeled Natural Background Condition and Reference Condition Approaches

The TN target for the Little Wekiva Canal was determined considering a combination of background modeling and direct reference condition approaches that calculated levels of TN that correspond to flora and fauna health. The watershed model estimated natural background TN concentrations and considered TN concentrations at an upstream station which was determined to be an appropriate reference site. The reference site determination was made based on the existence of sensitive taxa, good water quality, low chlophyll levels and overall healthy stream conditions.

EPA Analysis

The EPA determined that the use of background modeling and reference stream data to determine nutrient concentrations is protective of flora and fauna and is an appropriate and defensible method. These approaches represent TN levels at which a balance in flora and fauna are expected to occur and the designated use will be protected.

Little Wekiva Canal

The Little Wekiva River/Canal watershed is located in central Florida in the northwest corner of the city of Orlando. Eighty-five percent of the 21.4 square mile Little Wekiva Canal drainage area is located in Orange County, and the remaining 15 percent is in Seminole County. The entire Little Wekiva River Basin receives drainage from an urbanized 42-square-mile area west and north of downtown Orlando. The Little Wekiva Canal (canal) is located in the southeastern part of the Wekiva Study Area and in the southwest section of the Middle St. Johns River Basin. The canal originates as a north-flowing channel outlet from Lake Lawne that flows into Lake Wekiva and then into Lake Lotus (fed by Bear Lake) and finally into the Wekiva Swamp and Wekiva River. The canal segment makes up approximately 5.9 miles of the entire Little Wekiva River/Canal which is approximately 15 miles long. The Little Wekiva River/Canal is segmented by several lakes.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Little Wekiva Canal	3004	Stream Class III Freshwater	Nutrients Dissolved Oxygen	62-304.506(6) "The Total Maximum Daily Load is 42,624 lbs/yr total nitrogen"	TN = 42,624 lbs/yr Not to be exceeded at any time.

The determination of the allowable TN load is based on a watershed model which estimated natural background TN load. The estimated load was then allowed a specific increase above background TN levels based on conditions at an upstream station which was considered to be a reference site based on sensitive taxa, good water quality and stream conditions. The TN load corresponding to the reference chlophyll levels was then determined. A conservative midpoint between modeled natural background load and the regression based TN load for the reference station was used to determine the TN concentration and load for the TMDL. The final TN load 42,624 lbs/yr corresponds to a conservative chl *a* target of 3 µg/L which was based on a regression relationship between TN and chl *a* for the reference station.

Reference, Empirical and Input-Output Model Approaches

The TMDL to determine a TP target for Lake Apopka included several approaches - reference lakes, empirical models, and input-output models. Additional information was considered by the SJRWMD for assessing pre-impacted conditions and allowed a 10% decrease in transparency, consistent with the Class III transparency standard. After consideration of all approaches the final approach included the transparency provision adjustment.

EPA Analysis

The EPA determined that the use of the reference conditions, modelling approaches and utilization of the transparency standard to determine TP concentration/load is protective of flora and fauna and is an appropriate and defensible method. This approach results in TP levels at which a balance in flora and fauna is expected to occur and the designated use will be protected.

Lake Apopka

Lake Apopka is the fourth largest lake in Florida and is located approximately 15 miles northwest of Orlando in central Florida in the Ocklawaha River Basin. The lake has a surface area of approximately 30,100 acres and an average depth of 5.4 feet at a surface elevation of about 66.5 feet. Lake volume for the TP target is based on a long-term mean lake stage of 66.5 feet. Lake Apopka is the headwater to the Harris chain of lakes and the Ocklawaha River through its only surface outflow, (Apopka-Beauclair Canal). The Apopka-Beauclair Lock and Dam regulates discharge from the lake via the canal. Gourd Neck Spring is located in the southwest corner of Lake Apopka. Lake Apopka is part of the Ocklawaha River Basin and the watershed draining to the lake encompasses about 119,773 acres. Predominant land uses in the Lake Apopka watershed include agriculture (45%) and water (28%); additional land uses include urban and built up (10%) and wetlands (8%). The land use in Lake Apopka Outlet is primarily agriculture (3,637 acres; 28%), urban and built-up (2,922 acres; 23%), wetlands (2,345 acres; 18%), and upland forests (1,973 acres; 15%). Gourd Neck Spring is located in the southwest corner of the lake. Lake Apopka discharges to Lake Beauclair through the Apopka-Beauclair Canal.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Apopka, Lake Apopka Outlet, and Gourd Neck Spring	2835D (previously 2835B) 2835A, 2835C	Lake/Spring, Stream Class III Freshwater	Phosphorus Dissolved Oxygen	62-304.500(3) "The Total Maximum Daily Load for Total Phosphorus for Lake Apopka, which includes Gourd Neck Spring is 15.9 metric tons"	15.9 metric tons/yr Not to be exceeded at any time.

The TP load/concentration for Lake Apopka of 55 µg/L corresponding to the annual load of 15.9 metric tons/yr was based on an analysis prepared by the SJRWMD in June 1995 titled "Determination of Restoration Goals for Lake Apopka, a Culturally Eutrophic Lake." The document later became the journal article "Setting Water Quality Goals for Restoration of Lake Apopka: Inferring Past Conditions" by Edgar F. Lowe, Lawrence E. Battoe, Michael Coveney, and David Stites. The 1995 analysis included three approaches to determine an appropriate TP target: 1) reference lakes, 2) empirical models, and 3) an input-output model. For the reference lake approach, nine reference lakes were selected based on the consideration of geology and physiography and the consideration of morphology and hydrology.

The reference lake model yielded a range for TP of 11-76 µg/L (mean/median of 42/46 µg/L). The empirical model used an estimated pre-disturbance Secchi depth. This method analyzed various Secchi depths which were related to chlophyll to derive TP values. Secchi depth was analyzed in relation to macrophyte colonization of historical levels of native pondweed vegetation. The final TP from this approach was estimated at 32 µg/L. The input-output model utilizing varying assumptions of available light and lake color produced a predicted TP of 38 µg/L (range 8 - 77 µg/L). This model was based on a phosphorus budget developed for the 1989 – 1992 period with natural background land use conditions. Based on the three approaches, the range of probable natural background conditions for phosphorus was estimated from 32 – 46 µg/L. The SJRWMD then used two additional, independent means for assessing the pre-impacted conditions. After estimating the probable ranges in TP for the natural background conditions, the estimates were adjusted to allow for a 10% decrease in transparency, as allowed under the Class III transparency standard. Based on this analysis the estimated background TP concentration could be increased by approximately 19 percent while limiting the decrease in transparency to 10%. Applying this adjustment results in a range of 38 – 55 µg/L for TP. The three approaches described in the June 1995 analysis and the two additional approaches described above were reviewed by SJRWMD and in 1996 the Florida legislature, which adopted TMDL legislation specifically for Lake Apopka (Chapter 96-207, Laws of Florida), set a TP TMDL target for the lake of 55 µg/L which corresponds to the annual load of 15.9 metric tons/yr.

Modeled Natural Background Condition and Paleolimnological Approaches

The modeled natural background annual average TSIs for Newnans Lake ranged from 53.9 to 72.1 and a mean of 65.4 was considered the appropriate estimated natural background condition for Newnans Lake. The paleolimnological study results contained in Brenner and Whitmore 1998, indicated the range of diatom-inferred TP concentrations for historical lake water quality in Newnans Lake was estimated to be above a TSI of 60. The TP concentrations estimated from the background model and the range of estimated background TP concentrations from the paleolimnological study demonstrated that the models were consistent in producing protective conditions for Newnans Lake. The natural background condition was used to determine the annual TN and TP loads of 85,470 lbs/yr and 10,924 lbs/yr which represent a

59-74% reduction in TN and TP in the lake. The reduction of TN and TP is predicted to meet the natural background TSI.

EPA Analysis

The EPA determined that the various modeling and paleolimnological approaches used by the State to determine natural background TSI and natural phosphorus levels for Newnans Lake are appropriate and defensible methods. This approach is supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized above in 1. Trophic State Index to Derive TN and TP Approach. The TN and TP loadings derived from the background TSI value for Newnans Lake represent levels at which a balance in flora and fauna are expected to occur and are therefore protective of the lakes' designated uses and downstream waters. Additionally, the paleolimnological study that estimated pre-disturbance TSI and TP levels is consistent with the model results.

Newnans Lake

Newnans Lake is located in a topographical region of the state that is known as the Central Lowlands in central Florida near Gainesville. A large drainage area north of the lake supplies inflow via two major streams: Hatchet Creek and Little Hatchet Creek. The lake has a single major surface-water outlet, Prairie Creek which splits first into Paynes Prairie and secondly into Orange Lake by way of Camp's Canal. About 41% of the flow from Newnans Lake goes to the south into Paynes Prairie and the rest flows towards Orange Creek by way of Camp's Canal. The geology of the area is dominated by the Hawthorn formation, which is relatively impermeable and acts as a confining layer separating surface water from the influence of the Floridian Aquifer. Poorly drained soil and low elevation gradients of the area result in moderately high sheetflow and poorly defined channels. Ponds and wetlands occur throughout the area. The major sources of water to the lake include surface runoff, subsurface flow, and direct rainfall. The lake has an average surface area of about 7,200 acres and is a typical shallow basin lake. The maximum depth is not more than 12 feet, and the mean depth is approximately 5 feet. In 1966, a weir was constructed at the outlet of Newnans Lake by the Alachua County Recreation and Water Conservation and Control Authority to increase and/or manage desired water level. Analyses of pollen and diatoms in several sediment cores from the lake indicate that the lake was formed between 5,000 and 8,000 years ago and that it has been naturally eutrophic throughout its existence.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Newnans Lake	2705B	Lake Class III Freshwater	Nutrients, TSI	62-304.500(11) "The Total Maximum Daily Load for Total Nitrogen is 85,470 lbs/yr and for Total Phosphorus is 10,924 lbs/yr"	TN = 85,470 lbs/yr TP = 10,924 lbs/yr Not to be exceeded at any time.

The natural background annual average TSIs for the lake range from 53.9 to 72.1 and the mean of 65.4 was selected as the TSI target. The TP target chosen was the mean of the model simulated TP concentrations under background conditions and is consistent with the range of background TP concentrations determined from the paleolimnological study (Brenner and Whitmore 1998). Because the natural background TP determined by modeling is within the range of natural background TP determined by the paleolimnological study, use of the natural background TSI determined from the modeling is acceptable evidence that the natural background TSI of the lake was greater than 60. Therefore, the established TSI of 65.4 for the lake determined protective load targets.

Natural Background, Site-specific Watershed Condition and Site-specific TSI Approaches

A natural background TSI was calculated for Orange Lake using land uses for the Orange Lake watershed, Newnans Lake watershed, and Lake LoChloosa watershed. All land uses were converted to natural (forest/rural) land use conditions. In addition, the nutrient loads coming from the Newnans Lake watershed and the LoChloosa Lake watershed were set at natural background loads. Based on the site-specific conditions surrounding the lake, the final TSI target for Orange Lake was increased by a measure of 2 TSI units which was also consistent with the paleolimnological data for the adjacent waterbody, Newnans Lake.

EPA Analysis

The EPA determined that the natural background, watershed and site-specific TSI approaches used by the State to determine TP levels for Orange Lake are appropriate and defensible methods. These approaches are supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized above in 1. Trophic State Index to Derive TN and TP Approach.

The TP loads derived from the background TSI value for Orange Lake represent levels at which a balance in flora and fauna is expected to occur and are therefore protective of the lakes' designated uses and downstream waters. Additionally, the paleolimnological study for Newnans Lake which shares watershed location, geologic and soil characteristics of Orange Lake is considered an appropriate estimated of pre-disturbance TSI and TP levels.

Orange Lake

Orange Lake is located in the central lowlands of Florida. The lake is connected to the Floridian Aquifer in the southwest through a system of sink holes as well as through an outlet stream. The surface area of Orange Lake ranges from 5,000 to 14,700 acres, depending on the amount of rainfall. The maximum depth of the lake under average conditions is about 12 feet and the mean depth is approximately 5.5 feet. Major sources of water to the lake include: (1) interflow via Camps Canal-River Styx from Newnans Lake and Cross Creek from LoChloosa Lake; (2) surface runoff from the watershed; and (3) the direct precipitation into the lake. Water flows out of the lake through the sinkhole system located in the southwest part of the lake and through the outlet stream, Orange Creek. The long-term average TN/TP ratio indicates that the algal communities in this lake are likely limited by phosphorus.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Orange Lake	2749A	Lake Class III Freshwater	Nutrients, TSI	62-304.500(12) "The Total Maximum Daily Load for Orange Lake is 15,262 lbs/yr for Total Phosphorus"	TP = 15,262 lbs/yr Not to be exceeded at any time.

The natural background for Orange Lake was estimated using natural background models for Orange Lake watershed and also Newnans Lake and LoChloosa Lake watersheds which comprise the main surface waterbody flow inputs into the lake. For the background condition analysis, land uses in the entire Orange Lake watershed, including the Newnans Lake watershed, Lake LoChloosa watershed, and immediate watershed of Orange Lake, were converted to natural land use condition (forest/rural). In addition, the nutrient loads from Newnans Lake watershed and the LoChloosa Lake watershed were set at natural background loads as described in each of these TMDLs. The reduction of TP loading into Orange Lake based on natural conditions TSI with an allowance of 2 additional TSI units (final TSI of 60) would be equivalent to an approximate 2% load increase from natural background. The natural background annual average TSIs for Newnans Lake ranged from 53.9 to 72.1 and the paleolimnological study results contained in Brenner and Whitmore 1998, indicated the range of diatom-inferred TP concentrations for historical lake water quality in Newnans Lake was estimated to be above a TSI of 60. This approach is supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized above in 1. Trophic State Index to Derive TN and TP Approach.

Paleolimnological and TSI Approaches

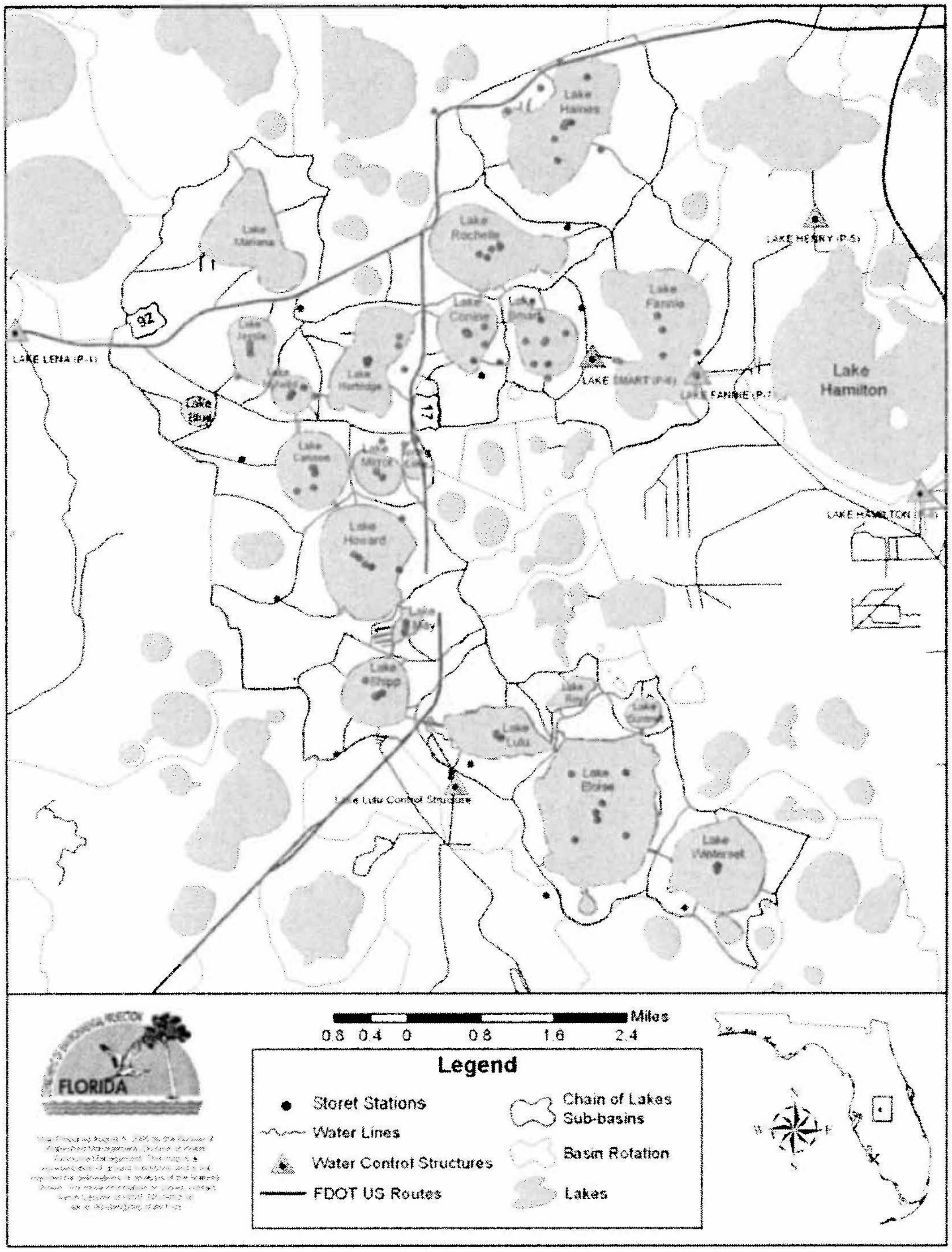
The three paleolimnological reports 1) 1995 Winter Haven Chain of Lakes Paleolimnological Report by Whitmore and Brenner, 2) 2001 Paleolimnological study by Whitmore and Brenner, and 3) 2003 Whitmore Report provided information to support the TSI target for the Winter Haven Chain of Lakes. All information provided in the reports to determine a target TSI value indicate the TSI target falls within the natural variability estimated for pre-disturbance conditions.

EPA Analysis

The EPA determined that the various modeling approaches used by the State to determine natural background TSI are appropriate and defensible methods. This approach is supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized in 1. Trophic State Index to Derive TN and TP Approach above. The TP loads derived from TSI values that constitute natural background and that account for natural variability and presented in each waterbodies' TMDL represent levels at which a balance in flora and fauna will occur and are therefore protective of the lakes' designated uses and downstream waters.

Winter Haven Chain of Lakes

Winter Haven Chain of Lakes in the Sarasota Bay–Peace–Myakka Basin



Eight of the Winter Haven Southern Chain of Lakes are located within the 32 square mile (20,257-acre) Winter Haven Chain of Lakes watershed within the larger Sarasota Bay–Peace–Myakka Basin in north-central Polk County. The Winter Haven Chain of Lakes watershed also includes eight additional lakes in the Southern Chain and five additional lakes in the Northern Chain. The eight waterbodies are connected by a series of canals and collectively discharge through a water level control structure on the southern side of Lake Lulu. Based on 1999 land use data, about 38 percent of the watershed is urban and built-up land uses. Water comprises another 37 percent of the watershed area. The watershed is within and surrounds the city of Winter Haven. The entire Winter Haven Chain of Lakes is designated as a Surface Water Improvement and Management waterbody by the Southwest Florida Water Management District.

Waterbody Name	WBID	Description Class	Listing Parameter	Chapter 62-304 Language	Approved Loading Targets
Lake Lulu	1521	Lake Class III Freshwater	Nutrients (Trophic State Index (TSI))	62-304.625(5) "The Total Maximum Daily Load for Lake Lulu is 84 kg/yr for Total Phosphorus"	TP = 84 kg/yr Not to be exceeded at any time.
Lake Shipp	1521D	Lake Class III Freshwater	Nutrients (TSI)	62-304.625(8) The Total "Maximum Daily Load for Lake Shipp is 97 kg/yr for Total Phosphorus"	TP = 97 kg/yr Not to be exceeded at any time.
Lake May	1521E	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (6) The Total Maximum Daily Load for Lake May is 88 kg/yr for Total Phosphorus	TP = 88 kg/yr Not to be exceeded at any time.
Lake Howard	1521F	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (2) The Total Maximum Daily Load for Lake Howard is 143 kg/yr for Total Phosphorus	TP = 143 kg/yr Not to be exceeded at any time.
Lake Mirror	1521G	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (7) The Total Maximum Daily Load for Lake Mirror is 55 kg/yr for Total Phosphorus	TP = 55 kg/yr Not to be exceeded at any time.
Lake Cannon	1521H	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (1) The Total Maximum Daily Load for Lake Cannon is 143 kg/yr for Total Phosphorus	TP = 143 kg/yr Not to be exceeded at any time.
Lake Idylwild	1521J	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (3) The Total Maximum Daily Load for Lake Idylwild is 64 kg/yr for Total Phosphorus	TP = 64 kg/yr Not to be exceeded at any time.
Lake Jessie	1521K	Lake Class III Freshwater	Nutrients (TSI)	62-304.625 (4) The Total Maximum Daily Load for Lake Jessie is 140 kg/yr for Total Phosphorus	TP = 140 kg/yr Not to be exceeded at any time.

Paleolimnological results from three reports provided information to support using the TSI target of 60. The 1995 Winter Haven Chain of Lakes Paleolimnological Report by Whitmore and Brenner provided predicted average TSI results for five of the southern chain of lakes used in the study for the current and natural background (pre-disturbance) conditions. Sediment cores were taken from the top of the sediment layer and also from the bottom layer of sediment layers. The report also provides a pre-disturbance TSI range using the 95 percent confidence interval. The following table shows the upper 95th percentile confidence interval TSI results for the pre-disturbance conditions. The 75th percentile value of the upper 95th percentile results is 57.5. Because it was noted that the method used by

Whitmore and Brenner underestimated water quality results and the average percent difference between the observed results and predicted results is about 6 percent, a corrective factor was applied to the pre-disturbance value of 57.5 resulting in a final TSI of 61.

Lake and Sediment Core	Sample Interval (cm)	TSI Average Upper 95th C.I.
Conine 17-I-1995-4 Paleo	100-102	52.8
Conine 17-I-1995-5 Paleo	75-77	61.0
Haines 27-I-1995-"11" Paleo	50-54	57.5
Haines 27-I-1995-"12" Paleo	50-54	55.2
Hartridge 16-I-1995-3 Paleo	50-54	56.1
Hartridge 16-I-1995-5 Paleo	50-54	56.5
Howard 17-I-1995-3 Paleo	75-77	57.1
May 17-I-1995-1 Paleo	50-52	68.2
May 17-I-1995-2 Paleo	75-77	55.2
75th Percentile Value		57.5
Predicted Condition (75th Percentile plus Percent Difference)		61.0

Additional paleolimnological work was conducted for Lakes May and Shipp, located in the southern chain of lakes, in 2001 (Whitmore and Brenner 2002). The average pre-disturbance TSI values using the TROPH1 diatom index method were 52 for Lake May and 67 for Lake Shipp. However, the 95% confidence intervals on the TSI values ranged from 49-55 for Lake May and 62-71 for Lake Ship. A third report was published in 2003 that included a pre-disturbance TSI value for Lake May using the WACALIB method (Whitmore 2003). The WACALIB method is considered to provide a more accurate pre-disturbance TSI condition than the TROPH1 method due to a more precise measurement for long term values. The report gives a comparison of the TSI results predicted with the WACALIB and TROPH1 models with the measured TSI results. The report presents the Lake May sediment core results using both methods. The TSI value of 58.3 for the deepest section of the core, obtained using the WACALIB method, is considered more accurate for defining the pre-disturbance condition. Given the range in predicted pre-disturbance TSI values from the three studies, the TSI value of 60, used as the target for developing the southern chain of lakes, is within the variability in the estimated TSI for pre-disturbance conditions. This approach is supported by the document "Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs That Are Protective of Designated Uses" (Attachment 2) provided by the State and summarized in 1. Trophic State Index to Derive TN and TP Approach above.

Conclusion

Based on the chemical, physical and biological data presented in the development of the H1 NNC's outlined above, the EPA concludes that all of the aforementioned H1 NNC's provide for and protect healthy, well-balanced biological communities in the waters to which the NNC's apply and are consistent with the CWA and its implementing regulations. More specifically, the NNC are consistent with both 40 CFR 131.11(b)(1)(ii), and the EPA's 304(a) guidance on nutrient criteria. In addition, paragraph 62-302.531(4), F.A.C. will apply in conjunction with all of the H1 NNC's addressed by this decision document in order to ensure attainment and maintenance of WQS of downstream waters, in accordance with 40 CFR 131.10. In accordance with section 303(c) of the CWA, the H1 NNC's addressed by this decision document, are hereby approved as consistent with the CWA and 40 CFR Part 131.

MAY 19 2015
Date

James D. Giattina
Director, Water Management Division

Attachment One

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
CE	Lake Wauberg	2741	62-304.500(9)		TN = 2,062 lbs/yr TP = 374 lbs/yr	
CE	Lake Yale Canal	2807	62-304.500(10)		TP = 2,844 lbs/yr	
CE	Lake Yale	2807A				
CE	Helena Run	2832	62-304.500(8)		TP = 18,302 lbs/yr	
CE	Little Lake Harris	2838B				
CE	Lake Harris	2838A				
CE	Lake Jesup	2981	62-304.505(1)	TN = 1.32 mg/L TP = 0.094 mg/L	TN=247.3 tons/yr TP=19.0 tons/yr	
CE	Lake Jesup Near St. Johns River	2981A				
CE	Little Wekiva Canal	3004	62-304.506(6)	TN = 1.02 mg/L	TN = 42,624 lbs/yr	
CE	Crane Strand Drain	3014	62-304.505(2)	TN = 0.78 mg/L	TN = 13.5 tons/year	
CE	Lake Griffin	2814A	62-304.500(7)		TP = 26,901 lbs/yr	
CE	Haynes Creek Reach	2817A	62-304.500(6)		TP = 20,286 lbs/yr	
CE	Lake Eustis	2817B				
CE	Trout Lake	2819A	62-304.500(15)		TN = 9,733 lbs/yr TP = 521 lbs/yr	
CE	Dora Canal	2831A	62-304.500(5)		TP = 13,230 lbs/yr	
CE	Lake Dora	2831B				
CE	Lake Beauclair	2834C	62-304.500(4)		TP = 7,056 lbs/yr	
CE	Lake Apopka, Lake Apopka Outlet, and Gourd Neck Spring	2835B	62-304.500(3)		TP = 15.9 metric tons/yr	
CE	St. Johns River above Lake Poinsett	2893L	62-304.510(1)	TP = 0.09 mg/L	TP = 89 tons/year	
CE	Lake Hell'n Blazes	2893Q	62-304.510(2)	TP = 0.09 mg/L	TP = 44 tons/year	
CE	St. Johns River above Sawgrass Lake	2893X	62-304.510(3)	TP = 0.09 mg/L	TP = 57 tons/year	
CE	Wekiva River	2956 2056A	62-304.506(2) & (3)	Nitrate = 0.286 mg/L TP = 0.065 mg/L		
CE	Wekiwa Spring (Orange)	2956C	62-304.506(1)	Nitrate = 0.286 mg/L TP = 0.065 mg/L		

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
CE	Indian River Above Sebastian Inlet	2963A	62-304.520(7)		TN = 684,715 lbs/year TP = 111,594 lbs/year	
CE	South Indian River	5003D				
CE	Indian River Above Melbourne Causeway	2963B 2963C	62-304.520(6)		TN = 189,068 lbs/year TP = 20,592 lbs/year	
CE	Indian River Above 520 Causeway	2963D	62-304.520(5)		TN = 147,524 lbs/year TP = 11,845 lbs/year	
CE	Indian River Above NASA Causeway	2963E	62-304.520(4)		TN = 173,232 lbs/year TP = 14,793 .bs/year	
CE	Indian River Above Max Brewer Causeway	2963F	62-304.520(3)		TN = 177,220 lbs/year TP = 9,320 lbs/year	
CE	Spring Lake	2987A	62-304.506(8)	TN = 0.959 mg/L TP = 0.021 mg/L	TN = 8,551 lbs/year TP = 641 lbs/year	
CE	Lake Florida	2998A	62-304.506(9)	TN = 0.699 mg/L TP = 0.023 mg/L	TN = 8,377 lbs/year TP = 571 lbs/year	
CE	Lake Orienta	2998C	62-304.506(10)	TN = 0.814 mg/L TP = 0.022 mg/L	TN = 6,092 lbs/year TP = 451 lbs/year	
CE	Lake Adalaide	2998E	62-304.506(11)	TN = 0.711 mg/L TP = 0.027 mg/L	TN = 3,003 lbs/year TP = 228 lbs/year	
CE	Lake Lawne	3004C	62-304.506(12)	TN = 1.107 mg/L TP = 0.055 mg/L	TN = 21,692 lbs/year TP = 2,005 lbs/year	
CE	Silver Lake	3004D	62-304.506(13)	TN = 0.575 mg/L TP = 0.015 mg/L	TN = 6,241 lbs/year TP = 370 lbs/year	
CE	Bay Lake	3004G	62-304.506(14)	TN = 1.108 mg/L TP = 0.019 mg/L	TN = 1,428 lbs/year TP = 109 lbs/year	
CE	Newfound Harbor	3044A	62-304.520(11)		TN = 30,661 lbs/year TP = 3,247 lbs/year	
CE	Banana River Below 520 Causeway	3057A 3057B	62-304.520(10)		TN = 144,780 lbs/year TP = 12,181 lbs/year	
CE	Banana River Above Barge Canal	3057C	62-304.520(9)		TN = 115,314 lbs/year TP = 7,825 lbs/year	

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
CE	Central and southern South Indian River	5003B 5003C	62-304.520(8)		TN = 278,273 lbs/year TP = 53,599 lbs/year	
CE	St. Johns River above Wekiva River	2893C	62-304.505(13)	TN = 1.18 mg/L TP = 0.07 mg/L	TN = 1,906 tons/year TP = 144 tons/year	
CE	Lake Monroe	2893D	62-304.505(12)	TN = 1.18 mg/L TP = 0.07 mg/L	TN = 1,892 tons/year TP = 143 tons/year	
CE	St. Johns River above Lake Monroe	2893E				
CE	St. Johns River downstream of Lake Harney and above Lake Jesup	2893F 2964	62-304.505(14)	TN = 1.18 mg/L TP = 0.07 mg/L	TN = 1,697 tons/year TP = 125 tons/year	
CE	Lake Harney	2964A	62-304.505(7)	TN = 1.18 mg/L TP = 0.07 mg/L	TN = 1,522 tons/year TP = 109 tons/year	
CE	Long Branch	3030	62-304.505(4)	TN = 0.71 mg/L TP = 0.14 mg/L	TN = 5.2 tons/year TP = 0.74 tons/year	
CE	Rock Springs and Rock Springs Run	2967	62-304.506(4) & (5)	Nitrate = 0.286 mg/L TP = 0.065 mg/L		
CE	Smith Canal	2962	62-304.505(10)	TP = 0.10 mg/L	TP = 1.95 tons/year	
CE	Lake Carlton	2837	62-304.500(17)		TP = 195 lbs/yr	
CE	Spruce Creek	2674A	62-304.435(2)	TP = 0.16 mg/L		27% reduction in TP
NE	Newnans Lake	2705B	62-304.500(11)		TN = 85,470 lbs/yr TP = 10,924 lbs/yr	
NE	Orange Lake	2749A	62-304.500(12)		TP = 15,262 lbs/yr	
NE	Alachua Sink	2720A	62-304.500(19)		TN = 256,322 lbs/yr as long-term annual average	
NE	St. Johns River above Mouth	2213A	62-304.415(2)		Estuarine 2213A to 2213F: TN = 1,376,855 kg/yr	
NE	St. Johns River above ICWW	2213B				
NE	St. Johns River above Dames Point	2213C				
NE	St. Johns River above Warren Bridge	2213E				

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
NE	St. Johns River above Piney Point	2213F				
NE	St. Johns River above Black Creek	2213I	62-304.415(1)		Freshwater 2213I to 2213N: TN = 8,571,563 kg/yr and TP = 500,325 kg/yr	
NE	St. Johns River above Palmo Creek	2213J				
NE	St. Johns River above Tocio	2213K				
NE	St. Johns River above Federal Point	2213L				
NE	St. Johns River above Rice Creek	2213M				
NE	St. Johns River above Dunns Creek	2213N				
NE	Suwannee River (Lower)	3422	62-304.405(1)(a)	Monthly avg 0.35 mg/L nitrate-N		
		3422A				
		3422B				
NE	Lower Suwannee Estuary	3422D	62-304.405(2)(c)	Monthly avg 0.35 mg/L nitrate-N		
NE	Manatee Springs	3422R	62-304.405(2)(b)	Monthly avg 0.35 mg/L nitrate-N		
NE	Fanning Springs	3422S	62-304.405(2)(a)	Monthly avg 0.35 mg/L nitrate-N		
NE	Branford Springs	3422J	62-304.405(1)(b)	Monthly avg 0.35 mg/L nitrate-N		
NE	Ruth Spring	3422L	62-304.405(1)(c)	Monthly avg 0.35 mg/L nitrate-N		
NE	Troy Springs	3422T	62-304.405(1)(f)	Monthly avg 0.35 mg/L nitrate-N		
NE	Royal Springs	3422U	62-304.405(1)(d)	Monthly avg 0.35 mg/L nitrate-N		
NE	Falmouth Springs	3422Z	62-304.405(1)(b)	Monthly avg 0.35 mg/L nitrate-N		
NE	Santa Fe River	3605A	62-304.410(1)	Monthly avg 0.35 mg/L nitrate-N		
		3605B				
		3605C				
NE	Arlington River	2265A	62-304.415(26)			30% reduction in TN
NE	Mill Creek	2460	62-304.415(37)			30% reduction in TN and 30% reduction in TP
SW	Lake Lulu	1521	62-304.625(5)		TP = 84 kg/yr	
SW	Lake Shipp	1521D	62-304.625(8)		TP = 97 kg/yr	
SW	Lake May	1521E	62-304.625(6)		TP = 88 kg/yr	

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
SW	Lake Howard	1521F	62-304.625(2)		TP = 143 kg/yr	
SW	Lake Mirror	1521G	62-304.625(7)		TP = 55 kg/yr	
SW	Lake Cannon	1521H	62-304.625(1)		TP =143 kg/yr	
SW	Lake Idylwild	1521J	62-304.625(3)		TP = 64 kg/yr	
SW	Lake Jessie	1521K	62-304.625(4)		TP = 140 kg/yr	
SW	Thirty Mile Creek	1639	62-304.605(1)	Monthly average TN of 3.0 mg/L		
SW	Lake Hunter	1543A	62-304.610(4)		TN - 6,579 lbs/yr TP - 489 lbs/yr	
SW	Rattlesnake Slough	1923	62-304.615(7)	TN = 0.84 mg/L TP = 0.48 mg/L		
NW	Little Gully Creek	1039	62-304.310(3)	TN = 0.63 mg/L TP = 0.051 mg/L		11.3% reduction in TN and 11.3% reduction in TP
NW	Minnow Creek	130	62-304.325(5)		TN = 21,310 lbs/yr TP = 3,195 lbs/yr	
NW	Sikes Creek	142	62-304.325(7)		TN = 21,819 lbs/yr	
SO	Caloosahatchee Estuary (Tidal Segment 1)	3240A	62-304.800(2)	TN = 0.45 mg/L	TN = 9,086,094 lbs/yr	
SO	Caloosahatchee Estuary (Tidal Segment 2)	3240B		TN = 0.53 mg/L		
SO	Caloosahatchee Estuary (Tidal Segment 3)	3240C		TN = 0.72 mg/L		
SO	Lake Trafford	3259W	62-304.810(2)(c)		TN = 56,617 lbs/yr TP = 3,348 lbs/yr	60% reduction in TN and 77% reduction in TP
SE	St. Lucie Estuary	3193	62-304.705(1)	TN = 0.72 mg/L TP = 0.081 mg/L		
SE	North Fork St. Lucie River (freshwater)	3194	62-304.705(2)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 140,134 lbs/yr TP = 15,765 lbs/yr	
SE	North Fork St. Lucie River (estuarine north fork)	3194B	62-304.705(3)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 103,747 lbs/yr TP = 11,672 lbs/yr	
SE	C-24 Canal	3197	62-304.705(4)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 348,957 lbs/yr TP = 39,258 lbs/yr	

District	Waterbody Name	WBID	FAC Rule Citation	TMDL Concentration Targets	TMDL Loading Targets	Percent Reduction Targets
SE	C-23 Canal	3200	62-304.705(5)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 242,202 lbs/yr TP = 27,248 lbs/yr	
SE	South Fork St. Lucie Estuary	3210	62-304.705(6)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 24,463 lbs/yr TP = 2,752 lbs/yr	
SE	South Fork St. Lucie River	3210A	62-304.705(7)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 90,471 lbs/yr TP = 10,178 lbs/yr	
SE	Bessey Creek	3211	62-304.705(8)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 29,981 lbs/yr TP = 3,373 lbs/yr	
SE	C-44 Canal	3218	62-304.705(9)	TN = 0.72 mg/L TP = 0.081 mg/L	TN = 242,929 lbs/yr TP = 27,330 lbs/yr	
SE	Pompano Canal	3271	62-304.726		TN = 11,590.98 lbs/yr TP = 923.66 lbs/yr	

Attachment Two

ATTACHMENT 1

Using the Trophic State Index Tool to Establish Nutrient Targets for Lake TMDLs that are Protective of Designated Uses

These materials have been prepared in response to EPA Region 4's request for added documentation regarding the Florida Department of Environmental Protection's (FDEP) past use of the Trophic State Index (TSI) as part of the development process in setting nutrient targets for lake TMDLs For over ten years FDEP has used, among other approaches, the modeled Natural Background TSI plus no more than a 5 TSI unit increase to account for the natural variability of lakes and to establish TMDL targets that are protective of designated uses. Currently, Florida has approximately 15 adopted lake TMDLs that used this methodology to establish TMDL targets. EPA's major issues regarding these TMDLs are (1) whether the Natural Background TSI+5 TSI unit approach establishes protective nutrient targets and (2) whether the nutrient target established using the Natural Background TSI+5 TSI unit approach constitutes site specific nutrient targets.

To address EPA's comments, FDEP examined the distribution of the variation in TSI of 34 reference lakes located across the state to show that the TSI of lakes with minimum human impact vary naturally. For the analysis the lakes were divided into groups of high color (greater than 40 PCU) and low color (less than or equal to 40 PCU). The analysis indicated that the 25th percentile of the distribution of standard deviation for both categories of lakes is approximately 5 TSI units, suggesting adding 5 TSI units on top of the background TSI is not only within the natural range of TSI variation, but is at the lower end of the natural variation. Because the reference lakes used in these analyses are lakes located across the entire state, the variation observed for these lakes should apply to all the lake nutrient TMDLs that have been adopted by FDEP in the past using the Natural Background TSI+5TSI method. However, with the implementation of the numeric nutrient criteria (NNCs), the FDEP does not plan to use the Natural Background TSI+5TSI unit method for future lake TMDL development.

The previous FDEP methodology for using TSI is valid because the approach maintains the general natural trophic state of the waterbody, within the realm of natural variability of reference lakes within Florida. The trophic classification (whether oligotrophic, mesotrophic, or eutrophic) is based on a broad range of TSI values, and a single point of TSI will not shift the waterbody from one trophic state to another. Basing the targets for chlorophyll a (Chla), total phosphorous (TP), and total nitrogen (TN) on the natural background plus 5 TSI units maintains the lake within known variability of the natural trophic state, providing for maintenance of the natural conditions of the waterbody and a well-balanced population of natural flora and fauna.

(1) **Advantage of using TSI**:

The federally promulgated NNC currently in effect for Florida's freshwater lakes and springs are in the form of concentrations for Chla, TN, and TP. These lake criteria were empirically derived from a statewide set of "typical" lakes that meet a certain set of characteristics of color and alkalinity. Dynamics of nutrients and their effects on response variables, e.g., Chla concentration, may vary greatly from waterbody to waterbody. When developing nutrient TMDLs for lakes, the preferred approach is always to consider as much local information as possible. In many cases, multiple lines of evidence, including lake trophic dynamics, paleolimnology records, watershed to receiving water relationships, water residence time, model simulated background condition, etc. can all be used in establishing robust nutrient targets that are fully protective of designated uses. Among these lines of evidence, the TSI can be applied as a valid and valuable tool in examining the nutrient dynamics in lakes.

As a valuable tool to characterize and classify lake nutrient dynamics, the TSI was originally based on a relationship tied to Secchi Depth. The index was developed in such a way that it has a numeric scale of 0 to 100. In many lakes, Secchi Depth showed a strong relationship related to the Chla concentration, which in turn is, in many cases, strongly related to TN and TP concentration. Based on these correlations, Chla-TSI, TN-TSI, and TP-TSI can all be calculated. This process brings Chla, TN, and TP under the same scale of 0 – 100, so that different aspects of the lake nutrient dynamic components can be compared to create insights for nutrient target setting (Carlson, 1977). The Chla-TSI, TN-TSI, and TP-TSI equations currently used by FDEP to calculate the lake specific composite TSI were established by Huber et al. (1982) after examining the Chla – nutrient relationships in more than 300 Florida lakes.

Because the Chla concentration and TN and TP concentrations are functionally related, one would expect that the TSI value calculated based on the Chla concentration (Chla-TSI) would generally be the same as the TSI calculated based on nutrient concentrations (Nutrient-TSI) if the major factors in a lake that control phytoplankton are nutrients. If the Chla TSI is significantly different from the nutrient-based TSI, there might be factors in the lake that depress or enhance the phytoplankton growth. These factors could be color, turbidity, water residence time, zooplankton grazing, or a range of chlorophyll/nutrient/ carbon ratios. The presence of certain algal species (e.g., nitrogen-fixers or microalgae) may also figure into the final target setting process. In addition, the TSI may also provide information regarding nutrient limitation in the lake. A nitrogen TSI much higher than the phosphorus TSI may suggest that nitrogen fixation is an important source of nitrogen for the lake, while a higher phosphorus TSI over the nitrogen TSI may imply an imbalanced nitrogen and phosphorus relationship due to internal loadings (sediment nutrient release) or ground water phosphorus input. In addition, the TSI provides a useful tool for selecting the desired trophic status among all competing designated uses. It has long been recognized that TSI often provides a very useful tool for setting up nutrient targets based on the hydraulic residence time of the receiving water (Vollenweider, R. A. and J. Kerekes, 1980). All of this information can be critical for setting the final nutrient targets.

(2) Natural Background TSI + 5 TSI Unit

This approach (natural background TSI+5 TSI) for establishing lake TMDL targets is appropriate where a model calibrated to current conditions (over a wide range of climatic conditions) can be used to establish with confidence the natural conditions for a lake.

In many cases, the model simulated TSI was used as one of several lines of evidence to set nutrient targets. Sometimes modeled TSI outcomes were used as the most important evidence to establish the water quality target for lack of other evidence and also because of the aforementioned information that the TSI can provide. In most cases, nutrient targets were established as model simulated natural background TSI plus 5 TSI units. As often also done by EPA, the natural background TSI may be simulated using watershed and receiving water models by converting all developed lands in the modeled watershed into upland forest and wetlands and removing all point sources and other sources such as septic tanks. Multiple years of annual average natural background TSIs are usually simulated and a long-term mean annual average TSI value is usually calculated for nutrient target setting purposes.

Because the long-term mean annual average natural background TSI represents a central tendency of the background condition, it is expected that the long-term mean annual average TSI will be exceeded at least 50% of the time, even under the background condition. This is because nutrient and Chla concentrations vary naturally, even under the natural background condition. In order to address the natural variation and avoid incurring too high an instance of Type I errors when establishing the nutrient targets, a certain amount of fluctuation should be allowed above the mean natural background condition. A practice used by FDEP in the past ten years in developing lake nutrient TMDLs is to add 5 TSI units on top of the background condition to set the nutrient target. Adding 5 TSI units on top of the model simulated background TSI provides a mechanism to address the variation of nutrient and Chla concentrations in natural lakes.

(3) Natural Variability of TSI in Reference Lakes

For the analysis, FDEP decided to determine the natural variability of minimally disturbed or reference lakes from across the state. The criteria used to identify reference lakes for this analysis was that the area-weighted Landscape Development Intensity (LDI) score for the watershed of selected lakes is less than 3.0. LDI scores less than 3.0 indicate natural areas with minimal landscape disturbance or urban development. As requested by EPA, FDEP separated these reference lakes into groups based on the color and alkalinity attributes that were used in the adopted NNC. Below are the general procedures that were used to subset the reference lakes.

Utilizing ArcGIS application, all lake WBIDs across the State of Florida were searched for WBIDs that only include land use types with an LDI score of less than 3.0. These lakes were further examined to find those lakes whose surrounding areas are mostly land use types with LDI scores of less than 3.0. This was the group of candidate reference lakes selected for watershed delineation.

Once the watersheds were delineated, the land use area-weighted average watershed LDI scores were calculated and only those lakes with an LDI score less than 3.0 were selected for the next step.

This set of selected reference lakes was then used in a query of the Impaired Waters Rule (IWR) database to retrieve data for color, alkalinity, Chla, TN, and TP. Those lakes that did not have any Chla, TN, and TP data or do not have sufficient Chla, TN, and TP data for calculating TSI for at least three years were removed from the list. The remaining lakes on the list were then checked against the lake WBIDs included on the FDEP Verified List to ensure none of the selected lakes were verified for nutrient impairment. The remaining reference lakes were used in the analysis of the variation of long-term annual average TSI for statewide reference lakes. **Table 1** shows the WBID number, the land use area-weighted watershed LDI score, the number of years that Chla, TN, and TP data are available for calculating the annual average TSI, the long-term average color, alkalinity, Chla, TN, and TP concentrations, the long-term mean annual average TSI, and the standard deviation of TSI for each reference lake WBID.

The reference lakes included in **Table 1** were divided into two groups based on their long-term average color values. Those lakes with the long-term mean color value less than or equal to 40 platinum cobalt unit (PCU) were considered low color lakes while those lakes with the long-term mean color value higher than 40 PCU were considered high color lakes (highlighted using yellow color).

Table 1 Reference Lake Characteristics

WBID	Watershed Land Use Area Weighted LDI	Number of Years	Long-term Average Color (pcu)	Long-term Average Alk (mg/L)	Long-term Mean Annual Average ChlaC (ug/L)	Long-term Mean Annual Average TN (mg/L)	Long-term Mean Annual Average TP (mg/L)	Long-term Mean Annual Average TSI	Annual Average TSI Standard Deviation
795A	1.9	9	5.89		1.07	0.23	0.007	17.6	2.4
783A	1.4	4	6.25		3.15	0.18	0.005	20.0	6.4
2918G	1.2	15	6.36	1.35	1.20	0.13	0.006	13.9	6.1
526B	2.0	4	8.54	1.00	2.76	0.18	0.005	17.9	7.1
516	1.8	4	8.92		1.28	0.33	0.006	19.6	1.9
555	2.0	3	9.78	16.79	2.43	0.35	0.005	19.1	4.6
662	1.7	5	11.00	1.00	1.29	0.29	0.007	18.3	5.5
526A	1.7	3	13.75	1.00	4.15	0.36	0.004	19.4	8.7
226	1.6	4	14.38	20.00	2.06	0.20	0.005	17.6	4.9
2541	1.6	12	18.34	2.30	3.01	0.26	0.025	31.6	5.4
2596A	1.4	3	18.89	1.75	2.35	0.40	0.017	31.6	1.9
2905C	1.0	6	22.13	2.43	4.26	0.37	0.015	33.3	7.3
83A	1.1	4	23.65	9.63	19.37	0.72	0.035	52.9	6.4
204A	1.7	3	28.33	1.00	1.92	0.42	0.007	23.0	7.3
145	1.0	3	28.61	8.38	11.79	0.64	0.026	45.6	12.0
3635A	2.3	8	32.73	1.70	2.42	0.61	0.014	32.6	4.9
3598D	2.5	9	35.93	19.80	2.44	0.72	0.039	36.8	4.3
239A	2.3	4	37.25	12.24	4.53	0.30	0.011	25.4	14.5
179A	1.2	5	40.00	14.54	20.11	0.80	0.040	55.3	4.5
3176	1.8	23	61.61	7.50	3.27	0.68	0.017	37.3	4.9
2339	1.3	8	65.23	29.55	3.47	0.51	0.069	35.8	8.9
3566	1.9	7	72.53	7.54	3.43	0.70	0.024	36.9	6.5
791N	2.1	13	74.54	4.96	8.58	0.76	0.032	44.4	10.1
2392	1.4	7	75.05		6.66	0.68	0.023	41.8	9.0
3472	1.2	4	79.78	1.95	18.26	1.57	0.025	48.8	17.0
3176A	2.2	7	93.00	3.98	3.95	0.87	0.024	42.2	4.1
3174E	2.2	8	100.95	4.13	5.34	1.08	0.037	46.2	5.2
3174D	2.2	8	164.54	4.13	5.92	1.12	0.047	47.9	6.2
1165A	1.2	5	225.85	16.41	15.99	0.85	0.056	48.2	13.9
3171A	2.2	16	248.26	3.00	4.30	1.60	0.026	43.0	4.5
2771A	1.2	3	271.22	63.92	4.58	1.32	0.056	45.8	6.3
2775C	2.1	4	325.00	13.75	6.48	1.48	0.121	51.9	5.8
3530B	1.4	8	329.50	1.00	8.90	1.26	0.073	51.7	7.1
2775F	1.7	5	503.33	15.29	4.38	1.90	0.077	50.7	3.2

The expected range of natural variability in average annual TSI was evaluated by using the distribution of the standard deviations of the annual average TSI values in the reference lakes and by lake group. Specifically, FDEP calculated the 25th percentile, median, 75th percentile, and mean values of the standard deviations (of annual average TSI) for each reference lake group (i.e., high and low color lakes). A summary of these results is provided in **Table 2**.

Table 2
Natural Variation of TSI

Color	25th	Median	Mean	75th
Low	4.6	5.5	6.1	7.2
High	5.1	6.3	7.5	9.0

As shown by these results, the 25th percentile of the standard deviations of the annual average TSIs are 4.6 units and 5.1 units for low color and high color lakes, respectively, which are both very close to 5 TSI units and can both be rounded to 5 TSI units. In addition, the median and mean TSI standard deviation of both low color and high color lakes are higher than 5 TSI units. This shows that even reference lakes with minimum human disturbance have significant natural variation and using the long-term mean as the TMDL target would have a very high chance of Type I error. The 5 TSI units that were added on top of the long-term mean for the natural background conditions represents the low-end of the variation (near the 25th percentile), indicating that adding 5 TSI units on top of the natural background TSI is very conservative.

In addition, the distributions of the standard deviations of the annual average TSIs for both high and low color reference lakes are very similar and, therefore, should be considered applicable to the background condition for all lakes. This indicates that adding 5 TSI unit on top of the background TSI not only is protective, but should also maintain the site specific nature of the nutrient target defined by the background condition simulated specifically for each lake. Therefore, the nutrient targets established by Natural Background TSI+5TSI unit approach is both protective and site specific.

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Landscape Development Intensity Index (LDI)

http://www.dep.state.fl.us/water/bioassess/ldi-hdg-bcg.htm

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